CHAPTERS ON THE NATURAL HISTORY OF THE UNITED STATES

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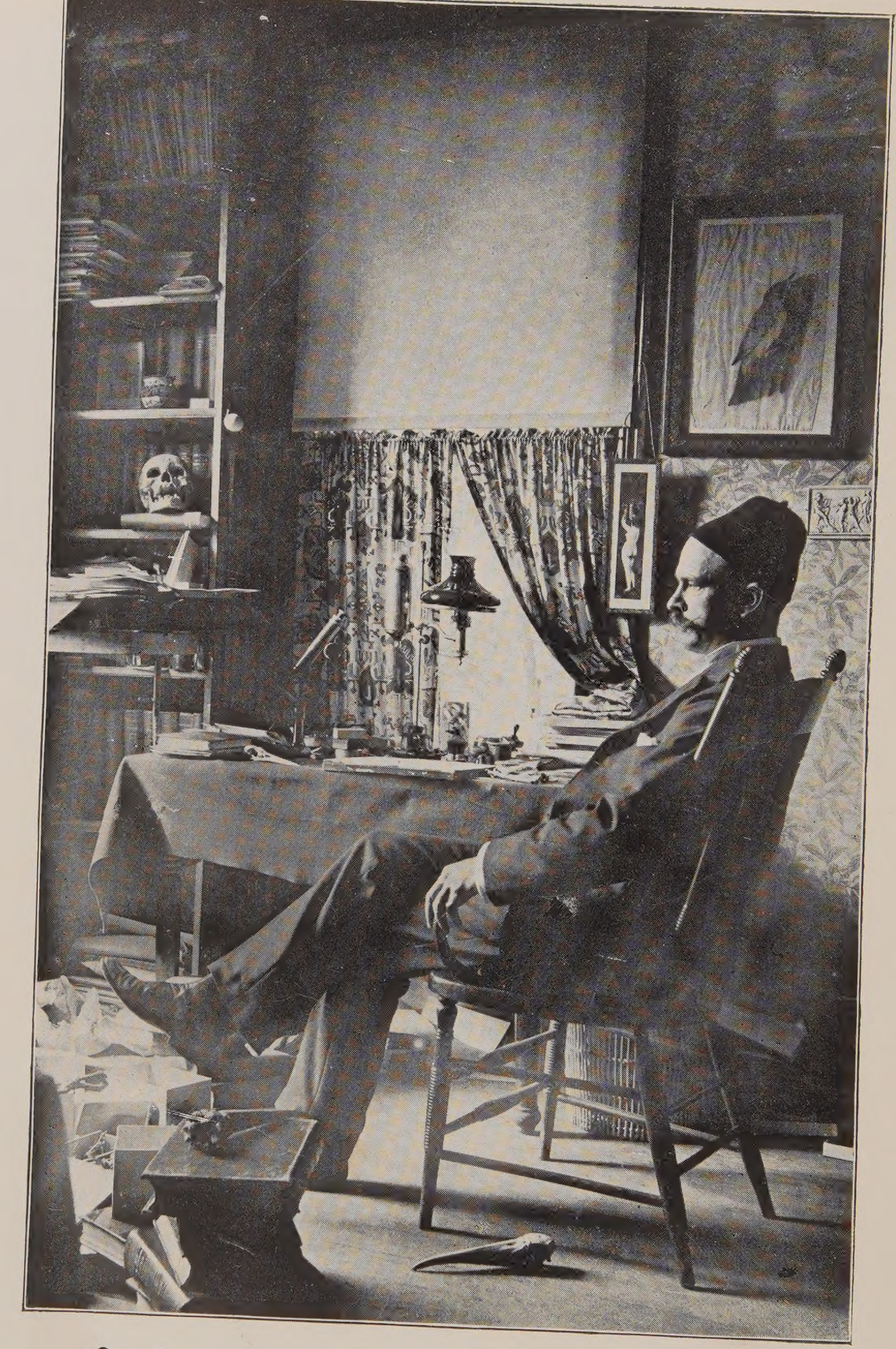

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R. W. Shufeldt.

CHAPTERS

ON THE

NATURAL HISTORY

OF THE

UNITED STATES

BY

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To

My learned and esteemed friend

THEODORE NICHOLAS GILL

I dedicate this Book,

not only

As a slight token of my personal regard,

but also

To express my profound appreciation

of

His genius, and for the power and

influence his many works

have had in

advancing the best interests of General Biology.

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INTRODUCTION

INTRODUCTION

IN offering to my readers the Chapters on Natural History found in the present volume, it is not with the intention of placing before them anything having the form of a systematic treatise upon the subject, but rather a series of nature stories selected at random by their author. During the past ten or twelve years or more I have contributed to the various popular-science magazines of this country accounts and descriptions of many of our better-known mammals, birds, reptiles, fish, and insects, and it is from these that the present chapters have been largely borrowed. In nearly every case, however, they have been extensively revised, augmented, and in a few instances new illustrations added to them. A few of these chapters appear now for the first time, never having been published elsewhere. Judging from what my many correspondents have kindly written me in years gone by, I feel safe in saying that my labors along these lines have been met with marked favor, and it is my earnest hope that there has been no falling off of this interest, and that gathered together in this their present shape these brief life-histories of many of our birds and animals will be received even with greater appreciation.

Technical descriptions have been largely disallowed place in these pages, as in this age of science the literature in such fields is very rich and ample, while but few really popular works upon natural history are being written. This further inclines me to believe that these chapters will be favorably regarded, especially by those who love to ramble in our fields and forests, explore along the banks of our streams and shores, and delight in reading about the forms in nature that they meet with there every day. I trust, too, that these accounts will stimulate others, and better pens than mine, to add still more to our knowledge of the habits of our United States animals, particularly those usually considered to be abundant and well known. Often these are the very ones that have been neglected, and the intimate habits of which we know the least about. Then many of the species in our fauna are now rapidly becoming extinct, and these especially need our attention at the present time. I will be very glad and feel more than repaid for my labor should my young naturalist friends, boys and girls, like this book, and wish to have it in their libraries. They have been largely in my mind while its pages were being written; and my own children, who have not only assisted me greatly in collecting some of the material therein described, but have heard them read ere they were sent to press.

It will be observed that quite a large number of the illustrations are reproduced from photographs of living animals of various species and kinds. These were all taken by myself from the living subjects, and nearly in every instance of natural size. Too much cannot be said in favor of the constant use of the photographic camera in zoology, and when by its means really first-rate, life-like pictures of any of our living forms are secured in natural attitudes, and with nature's surroundings, they should surely be published, and be made to take the place of many of the highly incorrect figures of our animals, still to be found in popular works upon natural history. Taxidermists and artists will then, I am sure, appreciate this feature in my book, for if anything be useful and helpful to them in their work it is good pictures of this class, used, as they safely can be, as models.

During the entire course of preparation of the volume, not a few of the works of other naturalists have been carefully consulted, and in many instances quoted from more or less extensively. Chief among these have been the writings of Professor Huxley; Darwin: from his "Voyage of a Naturalist;" Sir William H. Flower of the British Museum; the classical and voluminous writings of Alfred Newton; the very numerous and excellent contributions of Doctors Philip Lutley Sclater and R. Bowlder Sharpe; of Alexander Wilson; the Parkers; E. D. Cope; Gill, and G. Brown Goode in fishes; Packard and others distinguished in entomology; the unrivaled works in American ornithology of Robert Ridgway and of Chas. E. Bendire; those of the veteran in the study of reptiles, Dr. Albert C. L. G. Günther, F.R.S.; and a great many others.

In closing these introductory remarks, it gives me pleasure to say that it would have been practically impossible for me to have brought out this volume at the present time had it not been for the invaluable and substantial aid rendered me by my very good friend, A. C. Gould, Esqr., the esteemed editor of *Shooting and Fishing*, of New York City, N. Y. Mr. Gould not only greatly encouraged me to write this work, but, prompted by a generosity rarely equaled, presented me with the forty or more half-tone blocks upon which are engraved the reproductions of all of those animals photographed by me from life. For this very timely and friendly assistance I here extend him my most sincere thanks. All of my articles kindly published for me by Mr. Gould, from time to time in his admirable journal have been incorporated into the present chapters, and in many cases without any alteration whatever. I feel the deepest obligations, too, to Mr. Benjamin Lillard, the able editor of *Popular Science News*, of New York City, who, upon application, promptly loaned me many electrotypes of figures that during the past few years illustrated articles of mine in his excellent paper. I refer especially to the figures of the Violet Land Crab; the Sea Horse; *P. eques*; the Common Eel; head of Crocodile; the Gavial; the Horned Grebe; Black-throated Diver; Whiskered Auklet; Trudeau's Tern; Pelican; the Crossbills; and others. The text-matter which these figures illustrated in *Popular Science News* has also been largely reproduced in the following pages, and I am sure will add materially to the usefulness of the book.

CHAPTERS ON THE NATURAL HISTORY OF THE UNITED STATES

CHAPTER I.

Methods of Study of Natural History.

WHAT has been written of the poet can with equal truth be applied to the naturalist, for

> " 'T is long disputed, whether poets claim
> From art or nature their best right to fame;
> But art, if not enrich'd by nature's vein,
> And a rude genius of uncultur'd strain,
> Are useless both; but when in friendship join'd,
> A mutual succour in each other find."

And, as in the case of the poet, "naturalists are born and not made." A true naturalist has the spirit of genius born within him, and no amount of discouragement, or of misfortune, or of opposition will deter him in the fulfillment of his destiny. To such a one the methods of research in the fields he loves so well will be sought out and come to him, as it were, by second nature.

Were I asked what I considered to be the best qualifications for a naturalist to be possessed of, I should, without hesitation, answer, that, above all else, he must be a good observer; then, of equal importance is it that he should be endowed with a keen power of reasoning, in order to logically utilize what he observes. To these qualities of correct observation, and just appreciation of what he sees, must be added an unfailing store of patience, and a capability for work of any desired amount. True naturalists are true men in every sense of the word, and of them it may be said that no class possesses a higher regard for all the characteristics of the nobler side of human nature, as those of truth, candor, and unselfishness. The majority of our best naturalists, and especially those who come to be our best descriptive biologists, are born with the gift of drawing and painting, an art which in them rapidly develops. This is particularly true of those who lay any claim to being proficient in special departments, as those of ornithology, ichthyology, herpetology, and like sciences.

Of course, this in no way applies to those philosophic minds, who may be the expounders, the generalizers, or the authors of compendiums of any of these branches. But what I do distinctly mean is, that for one to be great in ornithology, for example, he must at least be capable of drawing and painting birds correctly, whether he exercises the art nature may have given him or not.

Many "closet-naturalists" there have been who, in their life's work, have demonstrated their extreme usefulness in advancing the biological sciences, while upon the other hand a great deal of the labor performed under such conditions has come to be the most serious stumbling-block in the way of sound progress. Consequently, whenever it becomes possible, animals and plants should be invariably studied alive, both in nature, and under all other conditions that opportunity may offer. It is only by such means that we can ever obtain a correct idea of form, color, habits, uses, and actions of certain organs or appendages, and much else besides.

Of the living specimens, too, that we study, we should always make good photographic pictures, as well as correct colored drawings. When dissections and other preparations are made, and no working naturalist can dispense with these, they, too, must be copied upon paper, and according to a prescribed scale, either by the means of pen, pencil, brush, and pigment; by the camera; or by the camera lucida; or by any other skillful contrivance in use for the purpose. In coloring dissections on papers, conventional tints should always be used, as red for the arteries and blue for the veins, and so on. If naturalists invariably employed the same colors for the same structures in productions of this class, a great point of vantage would be gained. And of still greater importance is it that a universal nomenclature of colors come into use, and our coming young naturalists of the present can do much toward the promotion and adoption of such ends.

When making notes upon animals, or indeed biological observations of any nature whatever, or drawings from life or dissections, they must be made as nearly coincident with the time of the observation as possible. In other words, leave nothing to memory, but make record only in the presence of the subject you purpose to describe. Field naturalists and explorers should be particularly exacting in this, their work being reduced to writing every twenty-four hours. By such methods alone can accuracy be insured, and progress be made certain.

In a naturalist's armamentarium there are two sets of things which are co-equal in importance to him, and both essential to his success. These are his implements upon the one hand, and his books upon the other. His microscope and its appurtenances; his guns and their belongings; his camera and its outfit; his drawing and coloring utensils; his other and many various instruments of precision—may be considered to be the active agents in his researches, while his library is the passive one. By the means of the first he obtains, studies, dissects, and makes descriptive record of material, while by the use of the second he compares the observations of others in every possible way; detects errors; ascertains the limitation of knowledge upon any particular point or subject; and finally, establishes in his mind the relative value of his observations, and exactly, in the event of their being published, to what extent they may be considered a contribution to the particular line of biological research along which they have been made.

Both books and implements should be of the very best obtainable: the first in the matter of recognized authority, and the second with regard to manufacture. The best test for the acquisition of either is the appreciation of the feeling for its need. Purchase only as the demand presses, and as the widening of your field requires it. Excess of either tools or volumes can but create lumber in the laboratory; demand care without the adequate increase in efficiency; and levy a pecuniary tax, which might have been used with greater power in some other direction.

In the matter of books, again, the naturalist will of course be greatly influenced by circumstances. If he has access to very extensive scientific public libraries, he needs at hand, of his own, only such works of reference as his researches require. These may be limited in some cases to text-books, practical works upon the use of instruments and dissections; compendiums, keys, manuals, lexicons, and the like, with perhaps some fifty volumes upon the general literature of his science. A dozen or more good journals and magazines should likewise find their way to his study table.

Eight times out of ten, I find no difficulty in entering my library and work-room in the dark, and finding the volume I need, or placing my hand upon any implement required. Precision, extreme neatness and order, economy in time carried to the maximum, and the minimum use of appliances compatible with the best possible results, will carry a capable naturalist through almost any undertaking in which he may engage, and stamp his daily surroundings with the unmistakable mark of success.

When we come to the material which it is our intention to examine, study, and describe, there is altogether another question involved. The more generous the supply of material the broader, clearer, and more comprehensive will be the results of our researches. If possible, the amount of material examined in the study of any zoölogical or botanical subject should be sufficiently ample as to insure beyond all peradventure a thorough elucidation of every detail of structure, and the widest opportunity for the data of comparison.

Say, for example, that it is a specimen of a tortoise that commands the naturalist's attention. Having obtained all the possible light upon its habits in nature, and its geographical distribution, and every fact and fiction that has appeared in regard to it in literature,—then seize upon all the material obtainable, enough in any event in order to fully exhibit the extremes of variation in size; the sexual characters; the eggs, embryos, and young at all stages; the fossil forms, if any are known; and finally, an abundance of similar material representing all the apparent allies of the particular form, either near or remote.

With this before one, compare and inter-compare all of its external characters, be they of whatever nature they may. Restudy its habits in confinement, and its physiological functions as far as they may be observed. Make of the specimen measurements, drawings, and photographs to an extent to illustrate all of these particulars. Next kill a series of specimens with chloroform, and make full comparative dissections upon these fresh cadavers, and especially with the view of ascertaining the appearance, relative positions, and morphology of all the parts and organs, *unaffected* by any preserving fluid. Colored drawings of all of these should be made, and then a similar series of specimens be consigned to a preserving fluid, and their morphology be re-examined, and several specimens injected (after the most approved methods employed by microscopists), hardened and stained, and then all the tissues examined by means of a lower power lens, as well as mounted sections of the same being made for a complete microscopical examination, with the view of making a full series of micrographs and colored drawings. Having accomplished all this, we are prepared to use our laboratory notes in writing out an account of the species; naming it, if the form be unknown to science; and suggesting a place for it in the system. This is simply a brief outline of the ideal path along which a biologist works, and hints as to the methods he adopts in his researches. Below this, his studies may be carried to any stage of completeness he desires, and I have known of youthful naturalists who have accomplished truly remarkable results by means of the most rudimentary appliances, and scarcely any assistance beyond the aid of a text-book or two in elementary zoology.

Fortunately in these days when a parent discovers that a child has taken to capturing snakes, shooting and skinning birds, drawing and painting butterflies and beetles, and possesses similar traits that become only more pronounced through opposition, the road is very clear as to what is to be done, for biology, elementary and otherwise, is completely woven into the very tissue and substance of our public-school system, and the best advice to be given in the premises is to suggest to the principal of the school to allow that particular pupil to add the elementary course in biology to his list of studies. Time will very soon demonstrate whether or no an embryo in biology is incubating. Should it happen that one is, then open every avenue to his or her requirements, for, indeed, good naturalists come not to us every day, and biological science rejoices in the acquisition of capable recruits to its ranks. Moreover in these days there is abundant room and occupation for them, and the world is wiser and better for their coming. Throw the books and the "paint-box" and the dissecting set in their way, and, to tell the truth, I know of no better mental training for *any* career in practical life than the one offered by a course in biology. A large share of success in life depends upon good powers of observation, the appreciation of the experience of others, and the logical application of these two combined. If a boy contemplates a course in medicine, for example, fortunate for him indeed is it has he the patience and understanding to obtain a score of crayfishes, and, with Huxley's book on the subject, sit down and master what is contained in those common-sense, philosophic pages, for should he do so, I will stake my life upon it, he will have acquired a kind of knowledge and a training that will stand him in good stead at every stage of his career, and give him a preparation that will easily enable him to outstrip his fellows in the school of medicine not similarly prepared, to say nothing of the benefit that will accrue to him in after life.

Things were very different thirty-five or more years ago, in my boyhood time, when a youth who gave evidence of any such tastes was commonly considered to be some sort of a juvenile crank, with a dash of insanity in his composition, and his father was advised to force him into one of the prescribed "professions," and make every effort to eliminate the eminently unpractical streak in his organization. The microscope was taken away from him; the collection of plants ordered destroyed; the living specimens under examination made to be let go, and the "rubbish" of birds' nests, eggs, skins, and what not destroyed, and the boy with the "bent" bent sure enough into channels for which he had no taste or capacity. Thanks to the present-day methods in biology, such procedures are fast becoming ones of greater and greater rarity.

CHAPTER II.

THE CLASSIFICATION OF ANIMALS.

(Taxonomy.)

WHEN we come to regard this earth as a whole, with everything upon it, it can be stated that it is made up of two kinds of matter. By far the lesser portion of this material is living matter, while the balance is not living matter, and for the distinct gap separating these two, the biologist knows of no link. Whatever life may be, when it ceases in the protozoan, in the animal, or in the plant, what remains is at once claimed by the world of lifeless matter, and is thereafter subject only to the chemical changes of either disintegration or of decomposition. Later on it may be taken up again into living material.

Now, the consideration of all living matter, with the phenomena it manifests, falls to the science or sciences of biology, while the dealing with dead matter belongs to another distinct category known as the abiological sciences. The science of zoology is an example of the first, and geology of the last. Again, we have animal life and plant life; organic forms and non-organic forms; and so, once more considered in its entirety, structures of all kinds exhibiting the phenomena of life are divisible into two great kingdoms—the *animal* and the *vegetable*. As we pass to the forms of the greatest simpleness in either of these, no zoologist or botanist can with a steady hand draw the hard and fast dividing line between them.

Still, this has been attempted, and Dyer has truthfully said that the "fundamental difference which separates the vegetable kingdom from the animal kingdom is to be found in the modes of nutrition which obtain in each. If we compare a plant and animal reduced to their simplest terms, and consisting, therefore, in each case of a single *cell*, *i. e.*, of a minute mass of protoplasm invested with a cell well, while the unicellular plant draws its nutriment by simple imbibition through the cell wall from the surrounding medium—a process which implies that all its nutriment passes into it in a liquid form—the unicellular animal is able to take in solid nutriment by means of interruptions in the continuity of the cell-wall, and is also able afterward to reduce this solid food, if of a suitable composition, to the liquid state. And not merely is there a difference of this kind in the mode, there is also one no less important, although less general, in the materials of nutrition. While under present terrestrial conditions those substances, or chemical combinations, which are required for the nutrition of animal organisms are, as far as we know, nowhere spontaneously produced—that is to say, nowhere apart from the influence of living organisms—materials derived wholly from the inorganic world are sufficient to sustain directly nearly the whole of vegetable life, and, therefore, indirectly, of all other life as well." As thus differentiated, then, we leave the dealing with vegetable life and plant-forms of every description to the consideration of the vegetable physiologist and the vegetable morphologist—to the botanist in the widest sense—and briefly take here into consideration only scientific classificatory methods as applied in the animal kingdom, though it may be said the same principles obtain in both. In biology, the term *taxonomy* is now frequently employed for the word classification. Each signifies the same thing, however—to *fix* objects or material in some definite order; to *arrange* them, or it, according to some defined plan adopted for the purpose.

In all classifications we base our arrangements upon the resemblances (homologies) or non-resemblances of the things classified.

Biological classification follows the same course, and, in it, it is the *structure* of the forms under consideration that is taken into account. The structure of animals constitutes the science of *morphology*. But morphology means nothing more than what we formerly comprehended by the term *anatomy*. Anatomically, the structure of organic forms is considered along two more or less distinct lines; the one being "gross anatomy," or all that pertains to the consideration of organs and parts in their entirety; the other being "minute anatomy," or *histology*, wherein the use of the microscope is essential to its prosecution, and the province of its department being the examination and comparison of the ultimate structural detail of organs and other parts.

Topographical anatomy treats of the *external* form and parts of animals, and may be studied upon the living specimens; that branch of anatomy dealing with the internal parts usually being undertaken only upon the dead bodies of animals.

Again, living animals are unceasingly undergoing a change of structure, or, in other words, they have a *development;* and this development may be anatomically considered at any stage, and for any fraction of time. This constitutes *developmental anatomy;* and in a similar way we have the province of *developmental histology.* The two combine in a special branch, or that of embryology, or the early stages of the development of the individual. *Fossil anatomy* takes account of the structure of the remains of extinct animals, and incidentally of their history in time. This is the science of *palæontology.* The facts brought to light by the study of embryology and palæontology largely assist in the corroboration of a natural taxonomy.

The path followed in a natural classification of animals is that one which first takes into consideration the very simplest forms known, and passes to those of gradually increasing complexity. In this course, *structural resemblances* constitute, when taken as a whole, the main guide and basis, checked, as ever must be the case, by what embryology and palæontology have to offer.

In writing upon taxonomy, Huxley has truly said that it "is conceivable that all the forms of life should have presented about the same differentiation of structure, and should have differed from one another by superficial characters, each form passing by insensible gradations into those most like it. In this case taxonomy, or the classification of morphological facts, would have had to confine itself to the formation of a serial arrangement representing the serial gradation of these forms in nature.

"It is conceivable, again, that living beings should have differed as widely in structure as they actually do, but that the interval between any two forms should have been filled up by an unbroken series of gradations; in which case, again, classification could only effect the formation of series—the strict definition of groups would be as impossible as in the former case. As a matter of fact, living beings differ enormously, not only in differentiation of structure, but in the modes in which that differentiation is brought about; and the intervals between extreme forms are not filled up in the existing world by complete series of gradations. Hence it arises that living beings are, to a great extent, susceptible of classification into groups, the members of each group resembling one another, and differing from all the rest, by certain definite peculiarities.

"No two living beings are exactly alike, but it is a matter of observation that, among the endless diversities of living things, some constantly resemble one another so closely that it is impossible to draw any line of demarcation between them, while they differ only in such characters as are associated with sex. Such as thus closely resemble one another constitute a *morphological species;* while different morphological species are defined by constant characters which are not merely sexual.

"The comparison of these lowest groups, or morphological species, with one another, shows that more or fewer of them possess some character or characters in common—some feature in which they resemble one another and differ from all other species—and the group or higher order thus formed is a *genus*. The generic groups thus constituted are susceptible of being arranged in a similar manner into groups of successively higher order, which are known as *families*, *orders*, *classes*, and the like." And, added to this, it may be said that, according to quite similar principles, we create the intermediate groups in nature, or those intended to contain the *subspecies*, the *subgenus*, the *subfamily*, the *suborder*, the *subclass*, and also such others as the *superfamily* and the *superorder*, and so on.

So much for true or *natural* classification; but we have another kind, differing from it, however, only in degree, and I refer to all forms of *artificial* classification. The artificial classification of living forms in nature depends upon the selection of easily observed features, most frequently *external* ones, as bases of divisions by means of resemblances or dissemblances. Itis likenesses in both instances, but in the natural one the morphological resemblances are taken in their totality; while in the artificial one, external characters, often only appearances, are given weight. To arrange living forms, in other words, in a natural classification requires a far-reaching knowledge of morphology on the part of the taxonomer; while an artificial one, although often convenient in some few particulars, may be conceived by almost any observer with common powers for comparison of objects. All birds, for example, might, in an artificial classification, be easily placed in one group or class; lines might then be drawn upon the fact that some birds were "land birds" and others "water birds"—ignoring the matter of structure entirely—and by similar reasoning make minor groups of "diving birds," "scratching birds," "climbing birds," "perching birds," and so on. All this can de done as a matter of observation of *habit* rather than of *structure.* To make the minor groups, however, *structural resemblances* of an easily accessible nature would next have to be resorted to, as shape of bills and feet; number of feathers in tail and wings; form, color, and even size, might also be pressed into service. In such classifications affinity becomes guesswork, and true relationships are thrown to the winds.

The simplest and most lowly organized of all known animal forms are those designated by biologists as the *Protozoa.* For the most part they are composed of single cells of living matter, and are elementary in all particulars. Multi-celled animals, or, as they have been called, the *Metazoa,* is a division created to contain all other animals. Spanning these two primary groups, we have certain protozoans in which *simple cells* are massed together in globular form.

The next most general morphological fact to be observed, and which can be practically utilized in a taxonomic way, is that the *Metazoa* are susceptible of division into two primary groups, on the basis that in one set we find the animals possessed of a central axis or cord, composed of either jointed osseous segments or vertebræ; of cartilage, or simply of the notochord; while in the remaining set nothing of the kind exists. In other words, we have the *Invertebrata* and the *Vertebrata.* But the latter possess also a spinal chord and brain, hence they may likewise be designated as the *Chordata;* the invertebrate group, wherein the nerve-cords are either ventral or lateral, are known as the *Nonchordata.* Other good distinctions also exist.

Here again, however, when we get down toward the simplest types, we meet with forms that approach with remarkable nearness the lowest ones of the alternate series. That is, in these cases certain invertebrates approach the Vertebrata in certain features, and, *vice versa,* we meet at the very starting point of the vertebrate series with most puzzling animals, as, for example, the *Tunicata;* the worm-like *Balanoglossus* and *Cephalodiscus,* and the famous Lancelet *(Amphioxus).*

The *Protozoa* have been well classified into their main groups and subdivisions by biologists; so, too, the invertebrate *Metazoa* have been similarly dealt with, and we meet therein with more or less natural divisions created to contain the Sponges *(Porifera)*; the jelly-fish, hydroids, and their allies *(Cœlenterata)*; the Worms *(Vermes)*; the starfish, etc. *(Echinodermata)*; the shelled animals *(Mollusca),* and other groups for crustaceans, myriopods, insects, spiders, and the various allies of these, living and extinct.

Passing to the Vertebrata, we meet at the very threshold of this phylum, as stated above, forms in regard to the taxonomy of which biologists by no means hold a unanimous opinion. I am inclined to think, however, that waiving such little violence as may be done, in any particular instance, the gain for convenience and classificatory simplicity will so far outweigh it that, in the light of future research, not only will *Amphioxus*, the *Tunicata*, and *Balanoglossus* be admitted, with Cuvier's *Vertebrata*, in the phylum Vertebrata, but both *Cephalodiscus*, as well as *Rhabdopleura*, will be placed there, associating them with *Balanoglossus*. Granting the admission of these three groups as the *Cephalochorda (Amphioxus)*, the *Urochorda (Tunicata)*, and the *Hemichorda (Balanoglossus)*, *Vertebrata*, as the *Craniata*, will stand as a fourth one, the whole constituting the great phylum of the VERTEBRATA.

The CRANIATA may be primarily divided into two main divisions, the first, the *Cyclostomata*, including the hagfishes *(Myxine)* and the lampreys *(Petromyzon)*. They are limbless, scaleless, round-mouthed, almost jawless forms that lead up to the fishes.

The second division of the Craniata—the Gnathostomata—includes the main vertebrate groups of Fishes, Amphibians, Reptiles, Birds, and Mammals. In a brief chapter, such as the one I am now writing, it becomes out of the question to discuss the minor divisions of these great groups, much less the morphological considerations upon which they are based. I must not neglect to point out, however, that Birds are linked to Reptiles *(Sauropsida)*, as are Fishes linked to Amphibians *(Ichthyopsida)*, many extinct forms corroborating the two alliances.

CHAPTER III.

SOME INTERESTING INSECTS, WITH NOTES ON THE CLASS.

(*Insecta.*)

ONE of the great kingdoms in organic nature are the *Invertebrata*,—invertebrates being animals without a vertebral column, and in this at least are distinguished from the *Vertebrata*, or vertebrated animals possessing a vertebral column or spine, it constituting in them the median part of an osseous or cartilaginous skeleton. Arrayed as one of the divisions of the *Invertebrata*, we find the *Arthropoda*,—joint-footed forms, including the Class *Insecta* (Insects), the largest one of all, as well as the Classes *Arachnida*, *Crustacea*, and *Myriopoda*.

As distinguished from a crustacean (crabs, lobsters, etc.), from an arachnid (spiders, etc.), and from a myriopod (centipedes, etc.), a true insect never has more than *six* legs; two antennæ; distinct head, thorax, and abdomen, with commonly two pairs of wings, and certain peculiarities in the organs and function of respiration. There are at least a million different species of insects in the world, and they occur in every known part of it. Not more than a quarter of a million of the earth's existing insect fauna has as yet been described, however, and thousands of volumes still remain to be written upon their biology. Fossil insects occur as early as the Devonian, and from this they lead up to the present era, becoming more and more like the groups now in existence. Many species have been preserved in amber, which is a fossil resin, as well as in gum copal; the former being usually extinct types, while the latter agree as a rule with the species still in existence. Some insects, such as certain ants and bees, may have a duration of life extending over seven or eight years; such species as the May-flies, on the other hand, have a duration of life not exceeding twenty-four hours. The period of existence in numerous species is greatly affected by the temperature; cold increasing the duration and heat diminishing it. Many insects are of vast economic importance to man; while in the economy of nature, especially in the matter of the fertilization of plants, they play no less an important role.

M'Lachlan remarks that among "the varied relations of insects to other classes of the animal kingdom and their mutual relations, no subject is more interesting than is that of parasitism. It occurs in almost all the orders, but in very different degrees. Whole groups are naturally epizoic, others entozoic, while a few (such as fleas and bed-bugs) can scarcely be arranged in either of these divisions, inasmuch as, although in one sense epizoic, it appears probable that they may occasionally be able to go through the whole of their life cycle without contact with the animals to which they otherwise appear especially attached." This is a very large and far-reaching subject, really a special department of entomology, and one, in some of its aspects, of great economic importance, and purely scientific in others.

Not a few insects are endowed with luminous powers, such as the fire-flies, cucullos, and some of the larval forms. The study of this extraordinary property is likewise deserving of the closest attention of the student. A variety of insects puncture all the various parts of trees and plants, giving rise to peculiar growths known as *galls*; but why these growths take place there has as yet been no satisfactory explanation.

The anatomy, classification, and geographical distribution of the insects found even within the boundaries of this country are, each and all, altogether too extensive subjects to be touched upon in a brief popular chapter about them, so the remainder of my space I will devote to short accounts of some special forms. Spiders and their allies, for example, constitute a very large group of insects; indeed, naturalists have created an entire subclass to contain them. They are designated as the *Arachnida*, and, as thus assembled, not only all the hosts of spiders in the world are included in it, but also their near kin, the scorpions, mites, daddy-long-legs, and the like. Much is already known about them; about their habits and geographical distribution; about their physiology and structure, and a great deal else. Scientists have written many treatises about them, and a great many have been beautifully drawn, colored, and given to the world on handsome plates. Yet, notwithstanding all this, it may be said that we have barely gained an insight of what we really ought to know about them and, in the ages to come, no doubt will. An entire history of this great sub-class of insects would make a large library of itself, and men have lived who have devoted their whole lives to the study of only certain families of spiders. Many years ago, the writer had a good friend who was an astronomer, and who had a private observatory near his residence. This gentleman once placed a species of spider in the distant end of the tube or barrel of his telescope, and for several days he unceasingly studied the insect as it created its beautiful web. It was one of those rayed webs made in one plane, and my friend was curious to know if there were either certain figures or angles used in its construction—in fact, was the spider's net built upon a definite geometrical plan—and he came to the conclusion it was not. His study well repaid him, however, for he acquired a very considerable knowledge of how the spider fastened its web together, and the plan it was apparently built upon. Any intelligent observer, by the aid of a lens, can gain a good deal of information about how spiders form their beautiful webs. By holding the insect properly the thread may be drawn out, and, in the common garden spider, for example, it will be seen to issue from a set of very remarkable organs at the under side of the distal extremity of the abdomen. These are called the spinnerets. There may be as many as a half a dozen of these, while at the apex of each there are to be seen upward of a thousand tubulets from which the separate filaments issue. So that the delicate silken thread as it is spun consists of several thousand strands, and it is manufactured in a set of special glands at he base of the spinnerets. At first it is in a fluid form, viscid and tenacious; but when exposed to the air it quickly hardens to form the thread. This last, the spider, by the aid of his hinder pair of feet, fastens to some object, which is easily effected by its adhesive qualities. Then, as he moves away, the thread is formed and drawn out. The manufacture of this material is of the greatest use and importance to these wonderful insects. Some use it to make their webs; some to enshroud their victims captured for food; others to construct trap-doors to various kinds of subterranean passages. By means of this thread spiders are allowed to lower themselves down from heights; others float in the air by it; some swing by it across small streams or ditches; and they put it to a variety of other uses. While out in my garden last summer I captured a great, big, dark-brown, hairy spider, that with ease made good headway over the ground, water, lily-pads, and anything on the surface. She carried with her a round ball, double the size of a buck-shot, which, when opened, was found to be filled with hundreds of young spiders. Originally, these were eggs and the mother spun over them this round, silken case. In this they had hatched, as my examination showed. Bringing out my camera, I obtained a fine photograph of this specimen as it ran over a little rocky ledge, and a copy of this is offered here to show the reader exactly how she looked. This species belongs to the family *Lycosidæ*, and is common in Maryland and other localities of Eastern United States. In certain parts of the tropics there are spiders of great size, and these species spin a web of no little strength; strong enough, indeed, to entangle small birds that have unwittingly flown against its meshes. We are all familiar, of course, with the peculiar cloth-like web built usually in corners and elsewhere, by the common house-spider, and how he runs out from the funnel-shaped angle of it, to capture insects that may alight upon its urface. All sorts of "cobwebs" constitute other weavings of these tireless spinners, and there is another family of these insects that are divers by nature. They weave remarkable little dome-shaped domiciles under water, and into these they dive with their captured victims. All spiders are aerial respirers, so that these forms have a way of filling their subaqueous structures with air, by carrying down globules of it entangled in the longest hairs of their highly pubescent bodies.

Dr. Claus, of Vienna, tells us that all spiders " are predacious, and suck the juices of other insects; nevertheless, the manner in which they get possession of their prey varies much, and often indicates the possession of highly developed instincts. The so-called vagrant spiders do not, as a rule, form nets to catch their prey, but use the secretion of the spinning glands only to line their hiding-places, and to make their ovisacs. They catch their prey either by running after it, or by springing on it. Most spiders rest in the daytime, and go out for prey in the dusk or in the night-time. Many vagrant spiders, however, hunt in the daytime, even when the sun is shining." There is another very remarkable thing about the *Dolomedes* shown in my illustration, and it is that the females are larger than the males, and more powerful. Other species may occupy their webs near each other in peace, or even temporarily a web in common, but this is by no means always the case, for at other times the female will lie in ambush for her partner and kill and devour him with quite as much relish as she does other insects. Not only this, but she will accomplish the same fiendish purpose while he is in the very act of fulfilling his duties toward her as her mate, or immediately thereafter. The male is well aware of this dangerous trait

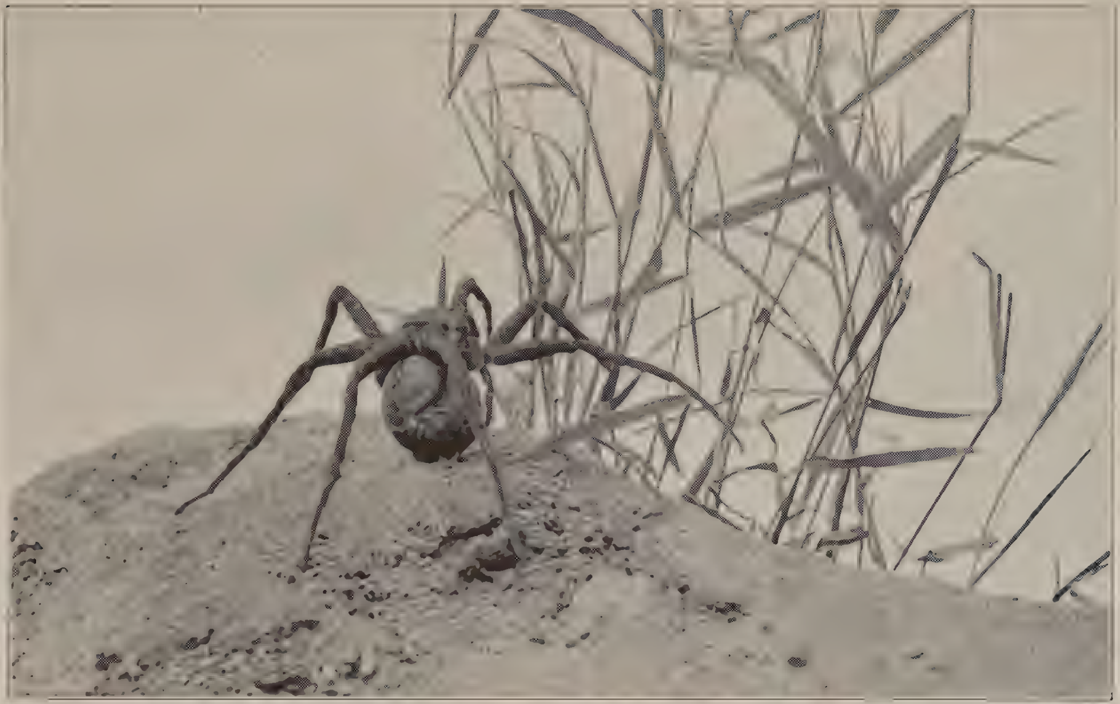


FIG. 1. SPIDER CARRYING HER YOUNG IN A SILKEN BALL. (*Dolomedes tenebrosus*, Hentz.)
From a Photograph by the Author. Natural Size.

on the part of his spouse, and consequently only undertakes to enter upon his amours with a due amount of caution.

The bite of some spiders is dangerous and extremely poisonous; when inflicted in the case of small animals it often causes almost immediate death. This is a bite, however, and not a sting, as in the case of their near cousins, the scorpions. The latter are connected with the spiders by a very remarkable in-

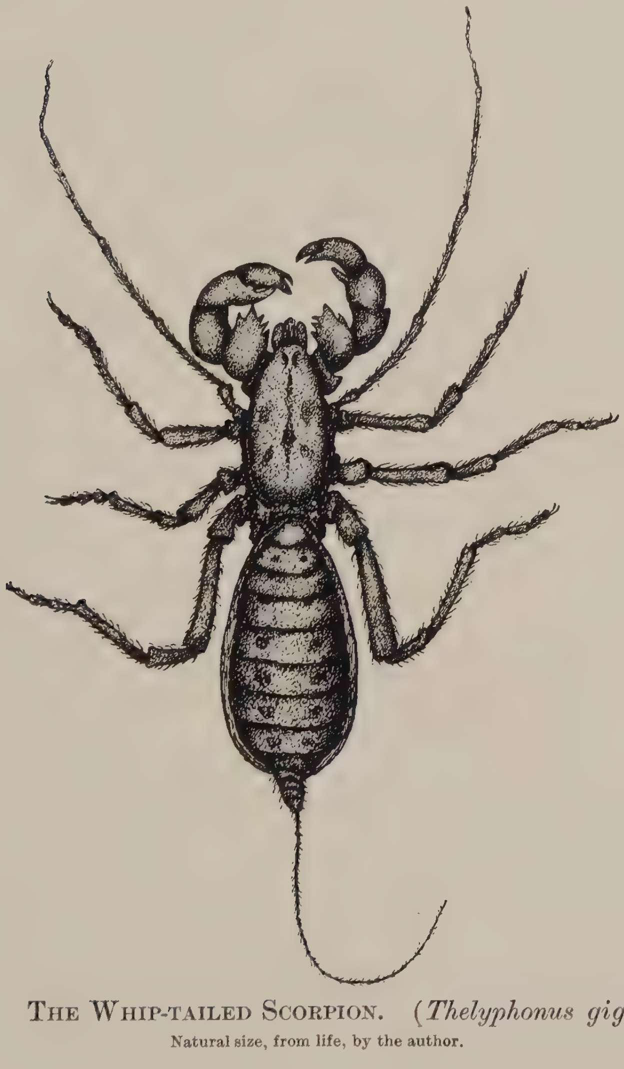


FIG. 2. THE WHIP-TAILED SCORPION. (*Thelyphonus giganteus.*)
Natural size, from life, by the author.

sect, found in certain parts of Southwestern United States and in Mexico. This scorpion-like looking spider (see figure) is called the "Whip-tailed Scorpion," or the "Vinigaroon," and is greatly dreaded by the people living in the countries where it occurs. When in New Mexico I obtained several specimens of this insect, and of one of them I made an accurate drawing, which is shown here in the illustration. The bite of this insect is poisonous, but I have never heard of a case where it has proved fatal in the case of man. Its tail is but a feeble lash, and structurally very different from the tail of a true scorpion. It is one of the largest insects we have in this country, yet contributions to its life-history are very much needed by entomologists.

We must not believe that spiders are altogether lacking in anything to recommend them, for most all of them possess a very great attachment for their young, while the two sexes in some species often live together in great harmony, even peacefully occupying the same web. Many spiders will go for a long time, even months, without food, but when this is plenty, their great voracious propensities are quickly exhibited. Spiders are often very curiously formed, while some of the so-called "jumping spiders" are most brilliantly colored. In the case of nearly all of them, they are both crafty and skillful in attacking and capturing their prey, and many of them possess an intelligence quite equal to that exhibited on the part of some ants. Speaking of ants reminds me of those interesting cases of "protective mimicry" in spiders, for in Brazil, in certain localities, there are species of ants and species of spiders so much alike that the ordinary observer can by no means tell them apart. Some species again closely resemble beetles, or even certain small mollusks, and there is one species so much like a little crab that most people would declare it was a crab. Certain insectivorous birds often feed upon spiders, but other spiders are so protected by spiny outgrowths, or are incased in dense horny armor, that the feathered denizens of the air let them severely alone. Many reptiles and small mammals feed upon these insects, while spiders kill and devour each other, and other insects also kill them. When collecting, years ago, in Louisiana, I found that one of the best places to look for spiders was in the newly formed nests of the so-called "mud-daubers,"—a kind of wasp. These insects stung spiders, paralyzed them, and then sealed them up in their nests as a food-supply for their young. Spiders are great drinkers of water, and feel the loss of that fluid very severely; this can be easily tested by depriving one of it, and then placing some within its reach. The insect will plump up imediately after it has had a good draught.

In concluding this brief account I must tell you that a great many fossil spiders have been found, even as far back as the coal formation. Some of the very best of these have been preserved in amber, which, as has been stated, is but a fossilized resinous germ of the ancestors of our coniferous trees. Even now, this process can be easily studied in any pine forest, for spiders still continue, as of old, to run up and down such trees, and when they become entangled in the clear exuding gum, they often become completely embalmed in time by the same material flooding over them. Time and fossilation does the rest.

Let us now consider some other group of this division of invertebrate forms, and it may be remarked that books and papers to the extent of a small library have been published upon those truly remarkable insects known as Dragon-flies, or, as they are familiarly called in this country, Devil's Darning-needles, and Horse-stingers by our young naturalist friends in England. Hundreds of beautiful lithographs in colors, drawings, cuts, plates, and engravings throughout entomological literature have also appeared, showing the vast variety and extraordinary forms comprising this group of the order *Neuroptera*, a group termed the *Odonata* by Kirby and others, who divide it into the two families, *Libellulidæ* and *Agrionidæ*.

A great deal has also been written and printed upon the marvelous structure of these insects; their strange metamorphoses, their habits and geographical distribution, much of which, owing to its technical nature, cannot be touched upon in the present connection. Moreover, in a popular work this will hardly be necessary, as probably all the readers of this chapter are familiar with the general appearance and parts of any of our typical American dragon-flies. There is, for example, in the Eastern United States, the big species that our boys and girls call the Snake Doctor, firmly believing, when they see it hawking about for its prey, that a snake lies concealed somewhere in the neighborhood. Older folk call this insect the Mosquito Hawk, a name more in keeping with its habits. Science recognizes two species of it, designating them as *Æschua heros* and *Æ. grandis*. As I have said, it is a large form, and frequently gets into our houses in the summer time, greatly frightening the children, and even carrying dismay among the grown people. The posterior part of its body is of a brilliant green color, elegantly marked with blue bands and spots, while its great eyes are truly objects of wonderful beauty. Then there are our pretty little species that are ever to be seen in spring and summer, flitting among the plants that grow in swampy places and sluggish streams. One of these is especially striking—the species with the slender, emerald-colored body, and the ample wings of jetty black; while another is of a gay, bright blue, with wings like gauze. Another, and one that has always been a favorite with the writer, is the species described by Count De Geer as *Libellula trimaculata*, it having a chalky white body, transparent wings, marked in the male by each having a dark patch near the body, and a more extensive area of the same, covering the outer part all to the tip. Three such deeply clouded patches ornament any one of the four wings in the female of this insect. A figure of this species is presented herewith (Fig. 3).

Among the high pine lands, in the month of June, we also find another species of this genus, *Libellula quadrimaculata*, having four spots upon each of its gauzy wings; and then there is that yellowish red fellow, so frequently seen hawking over the quiet pools and ponds during the same time of the year (*Diplax rubicundula)*, with its ally, *D. berenice.* But we can refer to no others here, and science has already described some 2,000 of these insects, occurring as they do in nearly all parts of the world.

The method of reproduction among dragon-flies varies somewhat with the species, and we have yet much to learn in regard to it. One thing is sure, however, and that is, the gravid female in some of the forms either lays her eggs singly or in masses, accomplishing the act by hovering over the water, and suddenly dipping the apex of her abdomen into that element, thus ejects the eggs, which slowly sink to the bottom. Others alight upon the stalks of certain aquatic plants, and backing down upon these till the abdomen is well beneath the water, there perform the act of oviposition. Still others deposit beneath the water, in incisions they make in the stems and leaves of plants, a single egg in each, effecting the necessary cut by means of a special apparatus that is a part of the economy of the insect. Sometimes the male descends with the female, and sometimes two of the latter sex insert their eggs into the stalklet of the same aquatic plant.

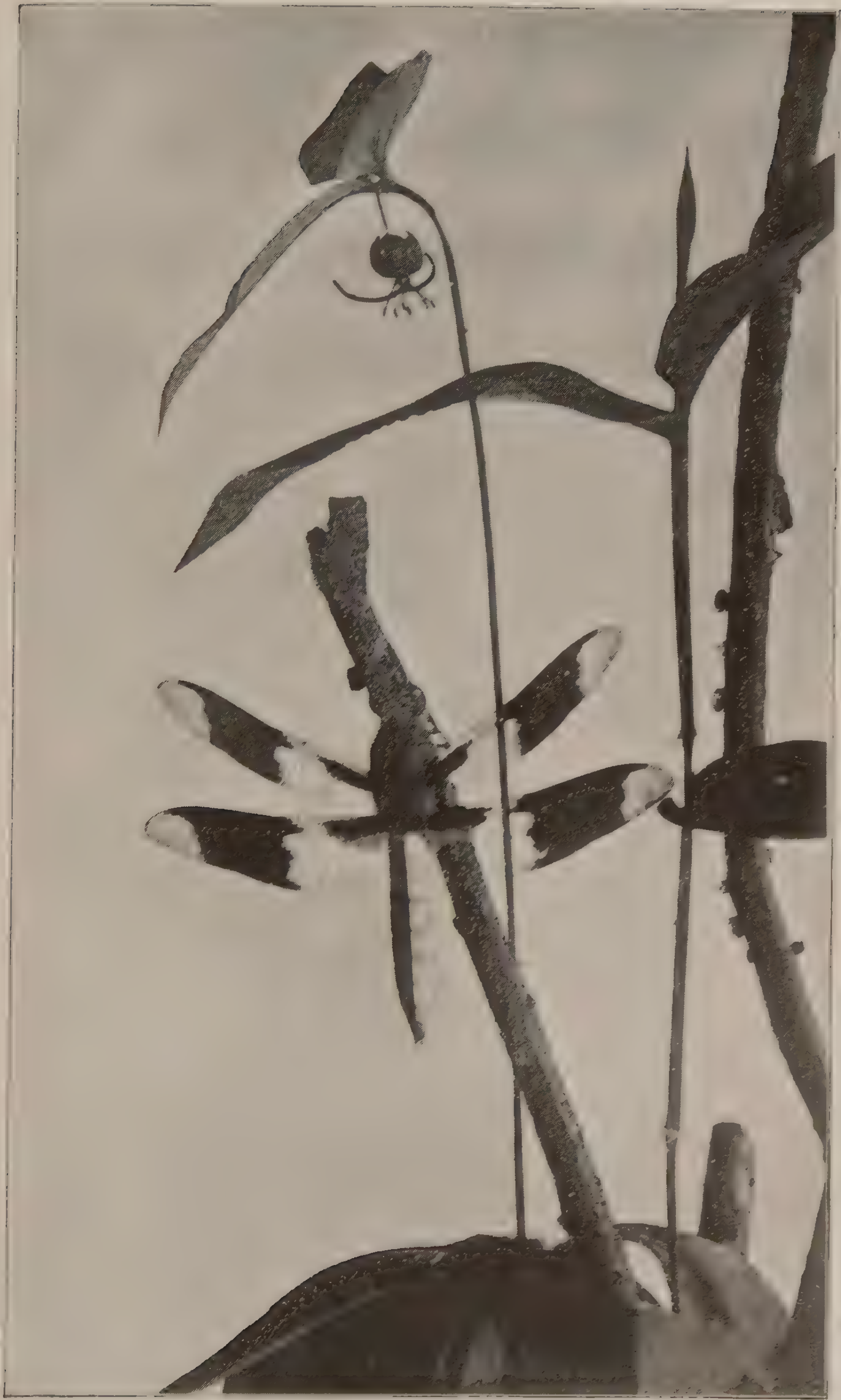


FIG. 3. A TYPICAL DRAGON-FLY (*Libellula trimaculata*).

Natural size. From a Photograph of the living specimen taken by the Author.

Uhler, a very close observer and competent entomologist, has noticed that *Libellula* "alights upon water plants, and, pushing the end of her body below the surface of the water, glues a bunch of eggs to the submerged stem or leaf."

These eggs are usually small and of a yellow color, while in some of the Agrions they are of a bright pea green, and our English students observe that in this group the females have been known to go down several inches beneath the surface of the water, to deposit their eggs upon the stems of the plants.

When summer is well advanced the eggs soon hatch, and then the larva of various species of Dragon-flies are easily to be obtained with an ordinary dip-net in any of our ponds or ditches. They are very active aquatic insects with six legs, big eyes, large head, and powerful jaws concealed by a facial mask. Constantly feeding upon the larvæ of mosquitoes and other noxious insects, they perform a service of untold good, a career the matured flies carry on in the air ever afterward until the day of their death. In fact, of all the insects known to me, none can in any way compare, in the matter of the amount of good done through the constant destruction of harmful insects, with dragon-flies of every species and kind. So far as man is concerned, the entire life of any one of these insects is one of beneficence of the mor pronounced character.

In speaking of the larvæ, Packard, our distinguished entomologist, has said: "Not only does the immature Dragon-fly walk over the bottom of the pool or stream it inhabits, but it can also leap for a considerable distance, and by a most curious contrivance. By a syringe-like apparatus lodged in the end of the body, it discharges a stream of water for a distance of two or three inches behind it, thus propelling the insect forward. This apparatus combines the functions of locomotion and respiration. There are, as usual, two breathing pores (*stigmata*) on each side of the thorax. But the process of breathing seems to be mostly carried on in the tail."

Perhaps the best way of all to study these insects, from this time on, is to place a lot of them in a good-sized aquarium, in which some small reed-like grasses and lilies have been made to grow. This I have done many times as a boy, and what I then saw has never been forgotten, nor the lesson lost. Here we may observe how the larva of the Dragon-fly passes into the pupa stage, the latter differing but very little from the former in appearance, and with habits but little changed. Simply it has the four rudimentary wing-cases somewhat larger, and it bears a more general resemblance to the matured insect, while there is scarcely any diminution in its activity or in its ravenous appetite for all kinds of aquatic insects and their larvæ.

At this time, by an interesting operation, the too-small larval skin is molted, and the soft, delicate pupa emerges therefrom, soon to attain a larger size, and then to have its body walls, or external skeleton, harden. Still later on, or along some time in July, these brown, often hairy, immature creatures are seen to climb up the stalks of the water plants, and cling thereto by means of their three pairs of legs, just beneath the surface of the water, or in some species above it. Then follows the most remarkable of all metamorphoses. Down the middle of the back there suddenly occurs a gaping rent, and from out of this, tediously, the tender imago of the Dragon-fly emerges. Flabby and soft, it slowly moves higher up the plant stalk upon which the pupa had climbed. Here it listlessly clings for an hour or more, during which time one may almost see the insect pass to the perfected stage. Its wings and body walls harden, the beautiful tints of the latter gradually become evident, and complete maturity soon follows. The warm sun quickly dries its hardening form, intensifying as it does so the gorgeous colors as they appear, and the insect is soon seen to rustle its elegant wings, bestir itself, test the powers of the functions of some of its various structures, and then in flight launch into the air.

As a rule the duration of life of dragon-flies is not long, and is made up of their incessant consumption of the many insects upon which they prey; of their extraordinary methods of mating; of their egg-laying, shortly after which they perish. M'Lachlan has remarked that these insects are "pre-eminently lovers of the hottest sunshine (a few are somewhat crepuscular), and the most powerful and daring on the wing in fine weather become inert and comparatively lifeless when at rest in dull weather, allowing themselves to be captured by the fingers without making any effort to escape. Many of the larger species (*Æschna*, etc.) have a habit of affecting a particular twig or other resting place, like a Flycatcher among birds, darting off after prey and making long excursions, but returning by the chosen spot."

In various quarters of the globe superb specimens of fossil dragon-flies have been discovered, and doubtless many more of these will be found from time to time. In closing this very brief account—barely a word as compared with what has been written about these insects—I would say science still remains in total ignorance of a great deal that pertains to them, and the writer knows of no chapter in the entire range of entomology that would better repay the careful study and observation of the entomophile, nor, indeed, a group from which, by patient research, more information could be derived, which, if carefully recorded, would form a more solid contribution to knowledge.

Another very interesting group of insects to consider is the one represented by our common Rear Horse (*Stagmomantis carolina*). These insects, known under a variety of other names to be hereinafter mentioned, are predaceous, and, therefore, of benefit to the agriculturist. They have a remarkable history, and a great many drawings of them have been published. The egg cases, similar to those now before us, have been figured in the fourth volume of "Insect Life," on page 244, while on the preceding page of the same work there is described a curious insect parasite of these eggs, which may, with interest, be read in connection with the former account.

Our species of "Rear Horse" are known far and wide in those parts of the country where they occur, and many who read this chapter will at once recognize the insect from the drawing I have made of one especially to illustrate it. Two egg cases are also shown in it attached by the insect on the frame to the left.

They have been called "Rear Horses" from the manner in which they hold themselves, and the position of the anterior pair of legs, giving a fancied resemblance to a horse in the act of rearing. Another name by which they are even better known is that of Mantis. Mantis is from the Greek word meaning "a diviner," and it has been applied to a genus of these insects, of which *Mantis religiosa* is the common form. Hence, also, another name, or the "Praying Mantis," that it likewise gets from the devout attitude in which it continually holds itself, and its solemn aspect withal. We shall soon see, however, that these insects, as a distinguished entomologist once remarked, "are not the saints but the tigers of the insect world." In one country or another they are also called "soothsayers," and "nuns" or "preachers," "saints," and similar appellations, which are simply so many more titles they by no means deserve. It was endowed with supernatural powers by the ancient Greeks, and the Arabs as well as the Turks contend that a Mantis is constantly engaged in prayer with its face turned towards Mecca. In some parts of Europe, it is said that the children will ask a Mantis to show them the way, and that it will, with one of its forelegs, indicate it to them with almost invariable exactness. They have the greatest faith in its powers to do this. But there are curious species of this family of insects found in many parts of the world, so there is no end to the legends and superstitions concerning them. A form found in Nubia is held in high veneration by the

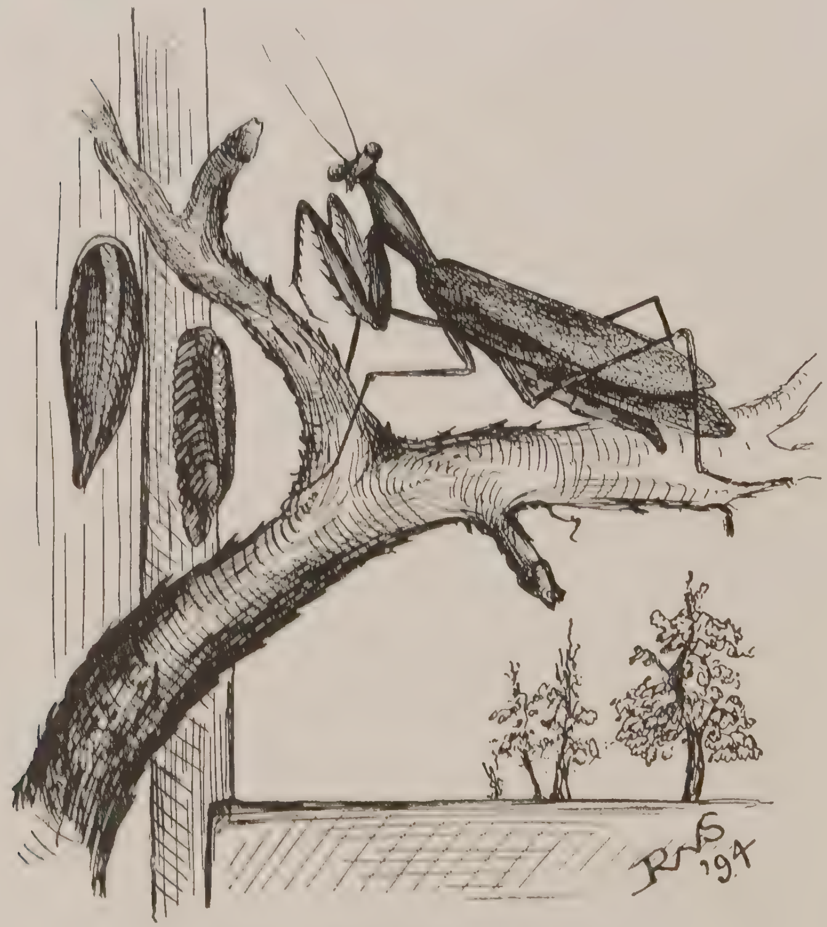


Fig. 4. The Praying Mantis.

Drawn from Life by the Author.

people of that country, while the Hottentots about worship a local species found in the land inhabited by that race, and they look for no better omen of good fortune than to have a Mantis alight upon them. It indicates a token of saintliness. Even the priesthood have not been above the promulgation of similar myths, for they say of St. Francis Xavier that a Mantis once lighting upon his hand, he commanded it to sing the praises of God, whereupon the dutiful insect loudly intoned a very beautiful canticle.

An old writer at my hand says, "The warlike disposition of the Mantis is put to a curious use in China, these insects being kept in bamboo cages for prize fights, like fighting cocks. At these exhibitions two of them are placed face to face; they raise their wings, their bodies tremble, and with the utmost fury they rush upon each other. They use their long forelegs like sabers, giving blow upon blow; sometimes the fight lasts several minutes. The victor then devours his enemy, which, all things considered, is a much more rational termination of a duel than is common among men. Were it introduced into the human code of honor, and the victor required to eat his victim, it would greatly tend to do away with one of our fashionable barbarisms."

On a number of occasions the present writer has tried this experiment with our United States species, and they will fight in exactly the same manner, the victor generally biting off the head of the slain one, and devouring a portion of the softer parts of his body.

If the reader will look at my drawing, he will see that, of the usual three pairs of legs possessed by the Mantis, in common with such a large proportion of the Class Insects, the two hinder pairs present us with nothing very unusual. The anterior pair, however, are very much modified, and in such a manner as to constitute a very cruel pair of weapons. The second joint is so fashioned that it can close into the third, after the manner of the blade of a penknife into the handle. The margins of the receiving groove of the third joint are armed with strong, movable spines. The tibial or blade joint also has a sharp serrated edge, being adapted to both cut and grasp with. A Mantis can extend and strike with one of these limbs as quick as a flash of lightning, and woe betide the unfortunate creature that comes within his murderous clutch, for his fate is sealed beyond all peradventure of a doubt.

It is a remarkable sight to watch one of these voracious, sanctimonious-looking fiends out for a hunt for food. A number of years ago I kept a large one twenty-four hours in a box without anything to eat. The next afternoon I let him walk out of his prison onto a window-sill, where the window-sash was down, and a dozen or more large flies had congregated. He came forth with marked deliberation, and with a dignified mien, as though he was about to burst with rage at the gross insult to which he had been subjected. I even thought I could detect the hate in his eye as he glanced obliquely at me, as his curious, quick-moving little head turned from side to side on the anterior end of his elongated, semi-erect prothorax. For all the world he looked as though he said, "Were I big enough I'd saber you, you scoundrel; but I'm not; and, however, I'm too hungry, and must get after some of those flies I see over there." Then, with an apparent effort, he bottled his rage, and assuming an exceedingly devout air, with his murderous, half-opened forelimbs held in their characteristic devotional attitude in front of him, he, with markedly slow and mincing steps, betook his way silently down the sill close to the sash. Ever and anon he would stand motionless as I patiently watched him. He would then cock his head from side to side in a vicious, knowing manner, as much as to say, " I know what I'm up to, but those flies don't." Just then a big blue one lit directly in front of him—zip, flew out one of the fellow's forelegs, and his victim was seized in a twinkling between its joints, as merciless as though he had fallen between the sharpened, miniature blades of two saws, closing together with flashlike rapidity. The other leg at once came into play in steadying his capture in front of his mouth, and the fly was soon devoured. Then that Mantis cautiously stalked about that window-sill until every fly upon it had fallen a prey to his voracious appetite.

In nature they will also catch and devour caterpillars, grasshoppers and other insects, while a large South American form will even take lizards and frogs, or some of the smaller species of birds.

Some of the foreign species have their wings beautifully modified so as to present the appearance of withered leaves, and this mimicry greatly aids them in deceiving their prey. Bates, the naturalist, found an Amazonian Mantis exactly mimicking the white ants upon which it lived, and the distinguished Wallace, of

East Indian fame, describes a species he saw in Java, that closely resembled a pink orchid flower, and "is said to feed largely on butterflies—so that it is really a living trap, and forms its own bait!"

Our young " preying beetles," when they are hatched, are like the parents except that they are wingless. These insects all belong to the *Mantidæ* of the order *Orthoptera.* They do not all deposit their eggs in a manner similar to the specimen shown in the above drawing. I have a good figure of an African Mantis at my hand that makes a very curious egg-mass (Monteiro's Angola), and there is an Australian form that has a very peculiar arrangement for depositing its eggs, which has been described by Mr. Webster.

Although these insects are so well known, it should not deter us from making still further investigation into their biology whenever good opportunity presents itself, and thus obtain a better knowledge of their habits.

CHAPTER IV.

CRAYFISH AND CRABS.

(*Crustacea.*)

CRAYFISH and Crabs belong to that very interesting Class of the Animal Kingdom known as the *Crustacea*, being arrayed in the Subkingdom *Annulosa*, created to contain the more or less nearly allied groups of the insects (*Insecta*), the myriapods (*Myriapoda*), and the spiders with their kin (*Arachnida*). In a more restricted sense they form the division *Arthropoda*, or the *Articulata* of some naturalists. In this country a great many kinds of them occur in its fauna, as all the various species and subspecies of crabs, lobsters, crayfish, king-crabs *(Limulus)*, water-fleas, besides a perfect legion of others, to which no common names have been given, and a host of fossil forms, such as the trilobites and their allies.

There is a very voluminous and helpful literature extant upon the biology of the *Crustacea*, the published labors of many able minds. One of the most useful books known to me on the subject is Huxley's "Crayfish," and it will give the student a very clear idea of the anatomy and natural history of one of the best known members of this group.

Fully examined in a comparative way in connection with the typical allied forms, the lobsters and crabs, the crayfish will lead to a general knowledge of the Class, and a good understanding of the habits and characters of the widely varying forms representing the many different orders of the *Annulosa*, apart from the insects, spiders, and myriapods.

Our United States crayfish belong to two well-marked genera, *Cambarus* and *Astacus*, the first being divided into five groups, and the latter genus all being contained in a single group. The most able and thorough work upon them known to me is "A Revision of the Astacidæ," of which Mr. Walter Faxon, of Harvard College, is the author. This fine quarto memoir gives a very complete account of all the crayfish of this country known to science up to the time of its appearance (August, 1885). Another American naturalist, Professor A. S. Packard, of Brown University, has also powerfully advanced our knowledge of these forms by his numerous contributions to the subject, not to mention those of the late Professor Cope, and of Dr. C. C. Abbott, F. W. Putnam, H. A. Hagen, S. I. Smith, W. F. Bundy, S. A. Forbes, Ralph S. Tarr, and W. P. Hay. There are upward of a hundred different kinds of crayfish in the United States, and new forms of them are constantly coming to our knowledge. In the U. S. National Museum, the crayfish and crabs are being best studied by Mr. James E. Benedict, Mr. Richard Rathbun, and Miss Mary Rathbun, and there is a large store of material illustrating this group in the collections of that institution.

The general form and appearance of a crayfish is so well known that no special description of one is here necessary, while in a brief chapter it is not possible to enter upon the highly instructive subject of the anatomy of these animals. One should turn to Professor Huxley's book for that, where it is given in great detail. Of our common forms, the ones best known to me are *Cambarus diogenes* and *C. bartonii robusta.* The first-named I had many opportunities to study in Louisiana, while collecting in that State many years ago, while Barton's crayfish I found in the country districts about the City of Washington, D. C. Both of these species are builders of the so-called "chimneys,"—structures that have given rise to no little amount of speculation as to their object and use. Many of these chimneys, constructed by *C. diogenes*, I found in the low, flat meadows, south of the city of New Orleans. Here they were usually built up vertically, even where they stood on the sloping banks of the ditches, and in many instances the taller ones were seen to have the apertures at their tops sealed over, and this condition obtained still more commonly among those of lesser stature. The sub-cylindrical passage used by the owner of one of these " chimneys " traversed its entire length, and down into the ground a varying distance below the level of the latter. When very low, one of these affairs reminded me more of a mound of mud, particularly when it was sealed over at its entrance, but after being carried up to a greater height, and especially when they were open at the top, perhaps they did appear as much like little earthen chimneys of cylindrical form as anything else. Where the ground was dry the method of construction could easily be observed, for they were evidently built up of small pellets of mud laid on in a single course, while at the bottom, by the pellets rolling down, a mound-like base was formed, around the outer boundary of which numerous loose pellets were scattered about. Where the ground was very wet the pellets, to a great extent, fused together, and the outer surface of the chimney or mound had simply a nodulated appearance, and the structure was much longer in drying out. Various different phases were to be seen between these two extremes. I tried to dig to the bottom of one of these passages, but owing to the nature of things in these wet lowlands of Louisiana, this was not feasible, for abundance of water was soon reached, and to follow the course of the passage was not possible by any ordinary means.

Often I have seen the crayfish in these abodes, and have captured them there, and I once caught one in the act of sealing in the top of its chimney, but I have never seen them at work during the actual building process. Mr. Ralph Tarr, who has written upon this subject (*Nature*, vol. xxx., p. 27), believes that the chimneys result from the excavation of the burrow, without implying design on the part of the crayfish. This is also the opinion entertained by myself, while Dr. C. C. Abbott holds the converse view, as does also his nephew, Mr. Jos. De B. Abbott, who has, by the aid of the light of a candle at night, seen the crays engaged in building their chimneys.

A few years ago, in Southern Maryland, I found the chimney of a Barton's crayfish. It was nine and a half inches in height, very smooth inside, and with the pellets distinctly individualized outside. Many of these were piled up about the base, and forty-two of them had rolled out beyond the latter. It was erected on level ground with a firm turf, and about ten feet from a small stream. In attempting to follow down the burrow, water was met with at fifteen inches, but the burrow was still followed for twenty-seven inches more, when it passed between two large rocks, too large to move, and so rendered further progress out of the question. In a few nights the cray abandoned this site, and burrowed again close at hand. In the same vicinity, right on the bank of the streamlet, I opened another; it only passed down eleven inches, when it terminated in a chamber about as big as my two fists, and placed at the side. It was below the water level, and contained a fine living specimen of *C. diogenes*. Beyond this was a low mound in wetter soil. Unlike the other two, the top of this one was sealed over, and the pellets nearly all run together. Upon taking this one up in my hand (it is before me now as I write), I found the sealing-in was very thorough, and the top as thick as the side walls. Inside, the cylindrical passage was as smooth as usual, and terminated in a smooth, concave, hemispherical end.

As to the manner of building. Mr. J. De B. Abbott gives a good account as cited by Faxon. The crayfish is seen to emerge partially from its burrow, bearing "on the back of its right claw a ball of clay mud, which, by a dexterous tilt of the claw, was placed on the rim of the chimney. Then the crayfish remained perfectly quiet for a few seconds, when it suddenly doubled up and dropped to the bottom of its burrow. There elapsed some three or four minutes between each appearance; but every time it came, it brought a ball of clay and deposited it in the manner I have described. About two-fifths of the balls were not placed with sufficient care, and rolled down outside of the chimney." Professor Faxon remarks further that "Dr. Abbott believes that the closing of the orifice of a chimney is merely the result of accidental falling in of pellets from the rim, loosened perhaps by atmospheric moisture. In some localities where the burrowing crayfish abounds, there is a weather proverb to the effect that, when the crayfish closes the opening of his chimney in dry weather, there will be a rainfall within twenty-four hours."

So far as I am aware, it is not known yet how the crayfish seals up the orifice of his tower. Possibly it may do it by backing up the burrow, and by turning around and about, manipulate the moistened clay or mud into place by the use of its lateral tail-fins and telson. That it is *not* due to the in-tumbling of the loose pellets on top, there can be no doubt, for in the specimen at hand the top of the sealed-up part is as thick as the sides (fully an inch), and exactly resembles them, while the *closed* apex of the passage inside is very smooth and carefully polished off. *Why* it closes in its tower is hard to tell. It may be that finding the orifice contracting too much, the cray seals up in order to prevent the upper rim of the tower falling back into the burrow ; it may be in order to shut out rain or rising water; it may be to prevent attacks of enemies ; or it may be done while the parent is laying her eggs at the bottom of the burrow. This all requires further observations on the part of naturalists. It is surely far easier for a crayfish to build a tower, even if two-fifths of the pellets do roll down outside, than it would be for the animal to carry *all* the pellets away from the mouth of its burrow, and submit itself to capture by an enemy every time it passed out with one. In short, it is the most convenient and most safe way to get rid of the pellets, besides being the least troublesome, and the method by which they are the least likely to roll back into the burrow.

Why crayfish build at all, I think, is due to the fact that they must have a safe place to lay and hatch their eggs, and also a place to escape at times from their enemies. That it does not always effect this latter will be seen from Audubon's account of the towers of *C. diogenes* which he figured in the plate with the White ibis (Vol. vi., p. 57). He says: "The crayfish often burrows to the depth of three or four feet in dry weather, for before it can be comfortable it must reach the water. This is generally the case during the prolonged heats of summer, at which time the White Ibis is most pushed for food. The bird, to procure the crayfish, walks with remarkable care toward the mounds of mud which the latter throws up while forming its hole, and breaks up the upper part of the fabric, dropping the fragments into the deep cavity that has been made by the animal. Then the Ibis retires a single step, and patiently waits the result. The crayfish, incommoded by the load of earth, instantly sets to work anew, and at last reaches the entrance of its burrow ; but the moment it comes in sight, the Ibis seizes it with its bill." It would appear from this that Audubon did not believe that the crayfish towers were structures erected upon some architectural design ; and his observations further go to prove that even the burrow does not always protect the unfortunate crustacean from its enemies. I do not place much credit in this story of Audubon's, however, for to fill a burrow having a "depth of three or four feet" with little bits of mud, from a mound rarely higher than *ten inches*, would take an ibis the best part of two hours; then it is not at all likely that all the pellets would go the bottom and fill the chamber there existing, even were the burrows perfectly straight and vertical, which they very rarely or never are. To say the least of it, Audubon, as a naturalist, was very imaginative sometimes, and I am strongly inclined to think that this ibis story is simply another example of it.

In this locality (Washington, D. C.) the burrowing crayfishes remain under ground during the winter, at points safe from freezing. This they do in a torpid condition, coming out early in the spring, after the cold weather is well by ; and it is soon after this that we begin to notice the appearance of their towers in their accustomed places. They feed, as Huxley says, upon "larvæ of insects, water-snails, tadpoles, or frogs, which come within reach" of its claws as the animal stands at the entrance of its burrow. Even "the water-rat is liable to the same fate. Passing too near the fatal den, possibly in search of a stray crayfish, whose flavor he highly appreciates, the vole is himself seized and held till he is suffocated, when his captor easily reverses the conditions of the anticipated meal."

"In fact, few things in the way of food are amiss to the crayfish; living or dead, fresh or carrion, animal or vegetable, it is all one." But I cannot in this short chapter say more in regard to these wonderful little animals; my space will not admit of it, and the subject is a very large one. It reads like a good novel in Huxley's celebrated treatise upon the group.

Crabs differ from the crays in having a much reduced and shortened abdomen, that would easily escape the notice of an ordinary observer, and is not used as a swimming organ, as is that part of the economy of a crayfish, from which latter they present many wide differences both in the matter of structure and habits, though "attentive examination shows that the plan of construction of the crab is, in all fundamental respects, the same as that of the crayfish." (Huxley).

I have availed myself of the opportunities to study many kinds of crabs, in not a few countries, and a great many parts of this country. One afternoon, when walking up over the steep hills in the rear of the town of Cape Haytien, Hayti, my attention was called to the numerous burrows in the clayey soil upon either side of the roadway. Further along in the forests these became still more numerous. These excavations were made by a species of burrowing land crabs, belonging to a genus well represented in the West Indian islands. In Jamaica, for example, there are thousands of them, and from their coloration they are called the Violet land crabs. I have made a drawing of one of these, and it is given here as an illustration of land crabs in general. They frequently live in the mangrove swamps and subsist upon fruits, though they will eat almost anything.

About the graves in the cemeteries of Jamaica hundreds of these burrows are to be seen, and the land crabs that inhabit them are known to go down and feed upon the corpses. West Indians, nevertheless, eat quantities of them, but they are very careful to capture only those that live a long way from the burying grounds. The natives catch them in ordinary box-traps, baited with a fruit of which this land crab is very fond. Often they are kept alive and fattened for the market. Once a year these Violet land crabs form in immense processions, a mile or more in length sometimes and over 100 feet in width. In this order they march down to the sea, and deposit their eggs. At other times they are nocturnal in habit, and come out of their burrows only to feed at night. Late in the evening I have seen them sitting at the entrances of their subterranean abodes, waiting for the deeper shades of night. They have large, powerful claws, which they use with great effect. After taking a hold with their big, merciless pincer, the limb suddenly becomes detached, and while you are doing your best to free yourself of the instrument of torture, the crab, minus its claw, makes off to its burrow.

Another very interesting crab is the famous Hermit or Soldier crab, of the Atlantic coast. In these the abdominal portion of the body is soft, and to protect this the animal runs it, tail first, as it were, into any dead and empty shell of suitable size and spiral form. In this the Hermit lives, with only his fore parts protruding, until he outgrows his house, when he quits it, to scramble into another of more convenient proportions. The structure and habits of these crabs are both interesting and instructive, and a great deal has been written about them. Spider crabs have a peculiar growth of a hairy appearance on their backs. Their legs are long, and their locomotion on land extremely awkward. Most of their time they spend in moderately deep water, and I have often taken them on the oyster beds of Long Island Sound, and the fishermen have told me that they play fearful havoc with the oysters, devouring great quantities of them. Fiddler crabs, of which thousands upon thousands lived in the short sea-grass that skirted the salt water, are very interesting. Such places were literally riddled with their burrows, and one had no trouble in capturing a pailful of these fellows. They make capital bait for the fishing of Black fish. Fiddlers are small crabs, with a pair of very unequal pincer claws. This has given them their name, for the larger claw has been likened to a fiddle, and the smaller claw to the bow. Females of this species have very small pincers of equal size. Several species of "fiddlers" are found upon our coast. Speaking of the naming of crabs, I would state here that the name "crab" itself is derived from *Carabus*, it being the Latin of the common edible species, and the one best known in ancient times to the Romans. The list of crabs now known to science is a long one indeed, and they are found in suitable localities in nearly every part of the world. Most of us are familiar with the little " oyster crab " found in those bivalves. The adult females of this diminutive species live within the gill cavities of oysters, while the males usually swim about at large. They have often been described by naturalists as different species, and there has been excuse for this, as the sexes are so essentially different in appearance. Mussels harbor another variety of these tiny crustaceans. The question as to how these little creatures originally came to take up their abode within the shells of living bivalves has not been settled.

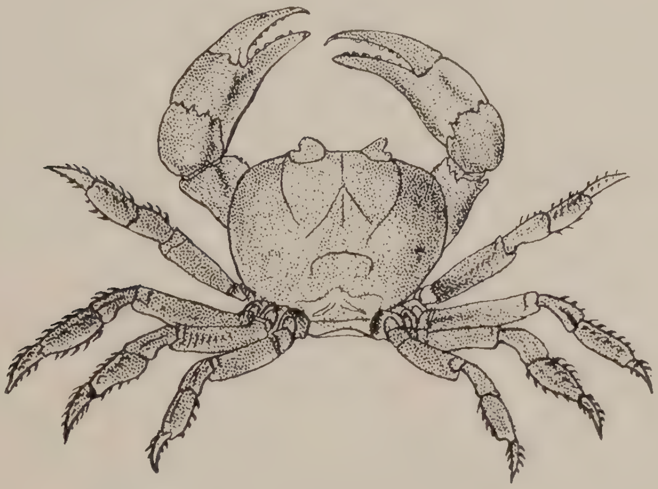


FIG. 5. THE VIOLET LAND CRAB.
Drawn by the Author.

Englishmen call these oyster-crabs " pea-crabs," and they stand among the smallest representatives of the group, the biggest form known being the crab-giants of Japan, which are considered a delicacy by the Japanese. A specimen of one of these has pincers each five feet long. Like our marine spider-crabs, its triangular body is not large in proportion.

In the islands of the Indian Ocean they have the " robber crabs "—species that approach the lobsters in their structure. But instead of living in the water, they burrow at the feet of the cocoanut trees, and live upon that fruit. In old times it was believed they used to climb the trees for these, but such a theory has become obsolete. They feed, doubtless, only upon the fallen nuts, and two opinions seem to be in vogue as to how they get the meat out of these. Some say they peel off the cocoa-fiber, then insert the pincer into the soft "eye" of the fruit, and by turning about work out the substance lining the interior. Others contend that, when it gets its claw into the eye-hole, the crab pounds the nut on a stone until it is broken open.

Robber-crabs line their burrows with the cocoa-fiber they tear from the nuts, and the natives in turn rob them of it to make their mats. These crabs also yield an excellent oil, derived from a mass of fat beneath the tail.

"Calling crabs" are remarkable fellows; there is a species of them in Ceylon that has one very small claw, while the other is bigger than its owner's body. When approached, this species brandishes its ponderous pincer at you in the most threatening manner possible. Less timid people than those awed by this behavior say that the crab is simply beckoning to you to advance, and hence the name that has been bestowed upon them. Ceylon also has a "racer crab" that the inhabitants have long voted to be a great nuisance. Its numerous and deep burrows made in the sandy roads of the island have to be continually looked after and filled up, by parties employed for that purpose. Where this is not done, accidents have occurred to horses and vehicles.

We have some beautiful species of crabs on our Pacific Coast, as the "Yellow shore crab" and the "Purple shore crab." Chinamen are fond of these, and cook them by stringing them on wires and hanging them over the fire. Both of these species are very numerous, though of small size.

Several years ago I was fishing off the coast of Connecticut, and was greatly annoyed by dogfish taking my hooks and bait. Finally I captured one of these troublesome fellows, and opened him to find my missing hooks. In his stomach were some four or five handsome little crabs, with very hard shells and thick claws. They were specimens of what every one there called "rock crabs," they being very common at the rocky reefs off shore, when the tide was out. In Long Island Sound we also meet with the "mud crabs," the "Jonah crabs," and the "stone crabs," and other forms.

Many interesting books have appeared on the developement of crabs, and the student should procure and read these, with a few species of crabs at hand, represented by young of both sexes.

CHAPTER V.

SAWFISH, RAYS, SHARKS, AND THEIR ALLIES, WITH NOTES ON DEEP-SEA FISHES.

(Elasmobranchii, etc.)

A GOOD many years ago there used to be in the town of Key West, Florida, a remarkable old curiosity-shop, that had a great fascination for me as a boy. The man that kept it was a sort of a taxidermist in his way, and in his musty old establishment there was a varied collection of odds and ends of marine relics that greatly interested me. And, although that was over thirty years ago, my instincts as a naturalist had been developing for several years prior to the time mentioned, and I can very well remember how I enjoyed being permitted to examine the various objects he had stored away on his shelves, or heaped up about the place. There were jaws of great sharks; quantities of shells and corals; sea weeds, big starfishes, and dried crabs; the shells of turtles and of spiny sea-urchins, and what not else. Among all this bric-à-brac from the depths of the sea there were to be noticed a score or more long, flat, oblong bones of an earthy color, with sharp, outward-projecting teeth all along the sides at near and somewhat irregular intervals. Some of these double-sawlike looking affairs were over four feet long, while others ranged all the way down until they came to be only a foot or more in length. It was the source of no little wonderment to me, then, as to what kind of an animal such an extraordinary weapon could possibly belong, and I am quite sure now that were this remarkable tooth-armed blade known only from a fossil one, and the remainder of the animal not known, it would by no means be every one who would suspect its having belonged to a fish. My Key West friend seemed quite familiar with the subject, however, and soon told me that it was the " saw " of the sawfish that excited my curiosity, and before I left Florida and Florida waters, doubtless I would see a number of these fish alive. His prediction was in part fulfilled, for upon one or two occasions, at least, I have had the opportunity to study the sawfish in nature. They are not uncommon upon the coasts of the peninsula, while in the inland everglades they are said to be very numerous. One that I read

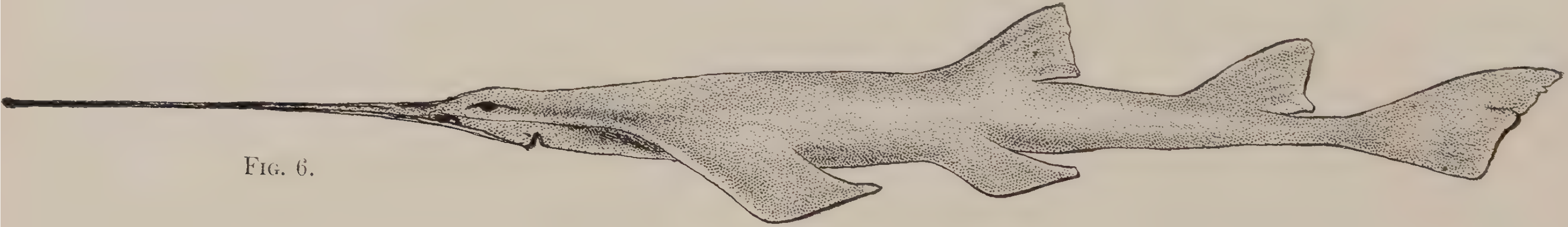


FIG. 6.

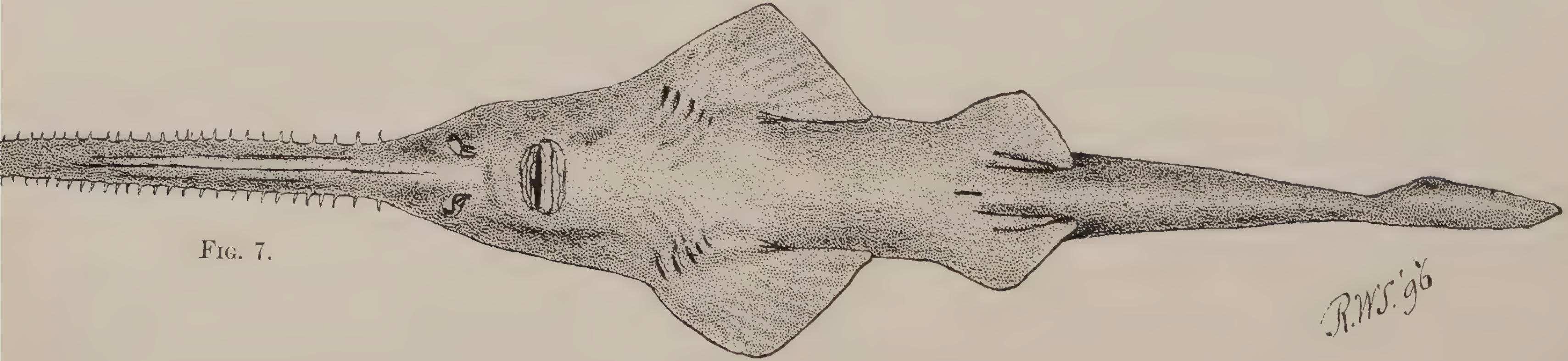


FIG. 7.

R.W.S. '96

SAWFISH (*P. pectinatus*).
Drawn by the Author.

Fig. 6. Side view of the Sawfish.

Fig. 7. The same seen upon its under side.

about, one of those rare northward-ranging stragglers, was captured at Cape May in 1878. This specimen was four feet wide, and over sixteen feet long, and possessed a forty-nine-toothed saw, measuring over four feet in length. Sometimes they grow very much bigger than this, even. Their mode of locomotion in their native element is a kind of a swimming waddle, swinging the head and saw from side to side. This action is powerfully increased when they are captured in seines, which is by no means an infrequent occurrence, and then the piscine Hercules soon cuts his way out. Fishermen cannot endure the sawfish, as their nets are thus so often ripped up. Many marvelous stories are told about the feats of the sawfish, of which probably only a small percentage are true. To illustrate the present contribution, I have made two drawings of this fish, and they are reproduced in Figs. 6 and 7. It will be observed how flat he is when viewed upon direct lateral aspect; this is quite in keeping with a habit he has of spending not a little of his time on the bottom. When looked at upon his under side (Fig. 7), most of his interesting characters come in sight. We then gain the best idea of the shape of his saw, the fins and the mouth, and other parts.

Ichthyologists have created the genus *Pristis* to contain the sawfishes, and our Florida species is known as *P. pectinatus.* They are most nearly related to the Rays, other very remarkable fishes that I shall have something to say about a little further on. Rays, Sawfishes, and Sharks all belong to the cartilaginous group of fish-forms, because they have skeletons composed only of cartilage. The Rays and Sharks taken together form the suborder Plagiostomata, and they are divided into a number of families, to the first of which the Sawfishes are relegated.

There are only about half a dozen species of sawfishes known to science, and they are all confined pretty generally to the warmer seas of the world. According to Dr. Gunther, who says, although " the sawfishes possess all the essential characteristics of the rays proper, they retain the elongated form of the body of sharks, the tail being excessively muscular, and the sole organ of locomotion. The " saw " is a flat and enormously developed prolongation of the snout, with an endo-skeleton, which consists of from three to five cartilaginous tubes ; these are, in fact, merely the rostral processes of the cranial cartilage, and are found in all rays, though they are commonly much shorter. The integument of the saw is hard, covered with shagreen ; and a series of strong teeth, sharp in front and flat behind, are imbedded in it, in alveolar sockets, on each side. The saw is a most formidable weapon of offense, by means of which the fish tears pieces of flesh off the body of its victim, or rips open its abdomen to feed on the protruding intestines. The teeth proper, with which the mouth is armed, are extremely small and obtuse, and unsuitable for inflicting wounds or seizing animals."

In the world's ichthyfauna there are certainly five families of Rays and Skates; of these we have in our own waters some very interesting representatives. For example, there is the famous Torpedo *(Torpedo occidentalis)* found quite abundantly along our Atlantic coasts, probably as far south as Virginia. I have made a drawing of this large Ray, and it is shown in Fig. 8 of this chapter. Physiologists have always taken great interest in this remarkable fish, from the fact that it possesses a peculiar organ upon either side of his body, between the pectoral fin and the head and gills. This organ is endowed with the power of generating electricity, and is under the control of the animal. An electric shock can be given voluntarily by the Torpedo, and it uses this with great effectiveness, either as a means of defense, or else to stun or kill the creatures on which it feeds. It is of no economic importance whatever, and fishermen, when they get them in their pound-nets, are very careful to let them alone, as the electric shock, even from an average-sized Torpedo, may knock a strong man down or completely paralyze his arms for some little time. These Electric Rays *(Torpedinidæ)* are also very generally known as "Crampfish," as the oil extracted from them is said to be a good remedy for rheumatism and cramps. The oil is obtained from the livers, and it is said, also, to make an admirable lamp oil. Large Torpedoes will yield as much as three gallons of oil, but the average is about a gallon and a half. They are captured with the harpoon. For one to receive a shock from the Electric Ray, the contact must be at two points, as the battery has all the characters of a manufactured one, and the electricity all the known properties of that fluid elsewhere. It will emit the spark; deflect the magnetic needle and decompose chemical compounds. On the upper side of the organ the electricity is positive, while upon the under side it is found to be negative. Many other forms of Electric Rays are found in different parts of the world, usually in tropical or subtropical seas; some of the big species attain to a weight of 100 pounds, and in these, as in all other varities or kinds of electric fishes, the body is without scales and smooth. Upward of thirty species of Rays and Skates are found upon our United States coasts, but man has no special use for any of them. The fleshy flaps of the big Barndoor Skate, however, have been used for food; the fishermen salting them down at Portsmouth, New Hampshire, and the fashionable restaurants in New York City serving them upon their tables. (Fig. 9). The enormous Devilfishes are Rays that may measure over thirty feet from tip to tip of their lateral pectoral fins; and in another place I have described the conflict I once witnessed in Key West harbor between one of these great Rays and a U. S. gunboat. The latter had to slip her anchor and call her crew to quarters in order to protect herself against the fury of the fish's onslaught, and being carried out to sea.

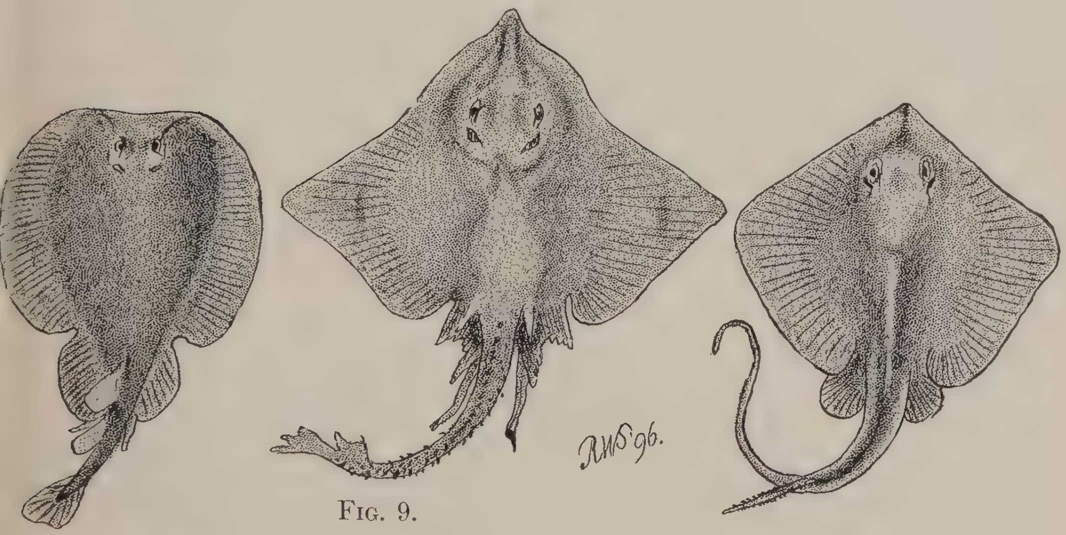


Fig. 8. Fig. 9. Fig. 10.

Rays and Skates.

Fig. 8. Torpedo (*T. occidentalis*).

Fig. 9. Barndoor Skate (*Raia lævis*).

Fig. 10. Sting Ray (*Trygon sabina*).

Skates and Rays spend most of their time upon the bottom, and when disturbed they swim off for a short distance, over the sand or mud, in an undulatory manner, by using the pectoral fins. Voracious in the extreme, they consume quantities of crustacea and mollusks of various kinds. By their powerful jaws and peculiar dentition, a big Ray can crush a hard-shelled crab in short order, and apparently with little effort. True Rays are egg-layers, but the Torpedoes or Electric Rays are viviparous. Rays' eggs are quite characteristic, resembling closely those of certain Sharks and Dogfish. They are parchment-like affairs, with tough, oblong, flat shells, which latter are drawn out into string-like, twisted horns. These serve as means of attachment to marine plants and other objects, to keep the egg-case at rest during the development of its contents. Female Rays are larger than the males, and their breeding habits are remarkable, as well as interesting. It will be seen from my figures that their tails are often drawn out into whiplike appendages, and the fins of the back are often modified. Sting-rays have these latter replaced by a strong spine, with serrated edges. I have collected these, and some of them have been as much as five or six inches long (Fig. 10). Painful wounds are inflicted by this dangerous weapon, for by violently lashing its whip-like tail, a sting-ray can easily lacerate most unmercifully its intended victim, and then if the mucus of the fish happens to enter the wounds, a poisonous effect ensues, thus aggravating matters still more. In some species there are two of these spines, while in other Rays the entire tail is bedecked with thorns, and this kind of ray is very generally eaten in Europe, in common with other species. Sting-rays often grow to be as big as the Skates, and specimens weighing 500 pounds are sometimes secured. Volumes have been written about the Rays (*Batoidei*) and much of it is very entertaining and instructive, but let us next pass to a brief consideration of their nearest allies, or to the Sharks.

Now, although the majority of species of Sharks are very different appearing fishes from the Rays, they have, nevertheless, many important characteristics in common with them. Then, too, even in the matter of appearance, the Sawfish, although most nearly related to the rays, has a form approaching some Sharks, while the Angel-fish *(Squatina)*, among the latter, is a very ray-like looking Shark. The group contains a number of families, including such well-known forms as the Dogfish or Hounds. Smooth or Blue Dogfish are very common in Long Island Sound, where, many years ago, I used to catch numbers of them off the reefs. In the same waters, I have also frequently taken the Spiny Dogfish, or "Bonefish," as the fishermen call it, off the coast of Connecticut. These little sharks are very abundant there, and in former years were of great economical importance, as barrels of oil were made from their livers, and the skins are of no little value, for, owing to the fine and peculiar nature of its scaling, it is used with great advantage, when dried, in polishing metals of various kinds, and for similar purposes. The female of this fish is considerably larger than the male, and I have understood that as many as 20,000 have been taken in a seine at one time. We might say a great deal more about dogfishes, but I prefer to pass to the consideration of some of the big man-eating sharks. The common "White Shark" occurs at rare intervals upon our Atlantic coast, and of it a great many accounts have been given. It is a perfect pest in the Mediterranean Sea, and as I write these lines, I have at hand the jaw of an enormous specimen of this species, that was collected on the coast of Italy, near the harbor of Naples. The fish was found dead upon the beach, and it had swallowed the entire body of a Neapolitan soldier, down as far as the man's knees. The victim was taken out, and it was found that he had on his uniform and part of his accoutrements. This jaw I have had for many years, and it is armed with hideous rows upon rows of jagged teeth. Only the front row of these is fully functional, and when any of them are lost they are soon replaced by the tooth from the row next behind. With the greatest ease, it can be slid over a large man. In the British Museum there is the jaw of a shark, probably of this species or genus, that belongs to an individual upward of forty feet in length. Such a shark, however, is but a pigmy to the specimens that existed in former ages of the world's

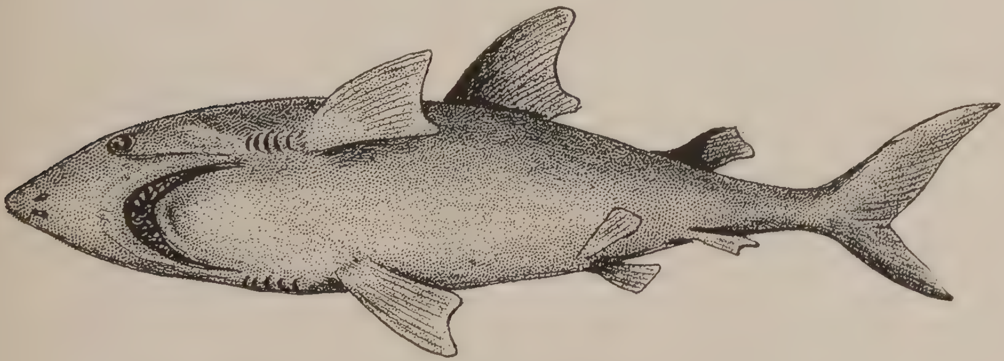


FIG. 11. THE WHITE SHARK (*Carcharias*).

Drawn by the Author and very much reduced.

history. In the phosphate beds of South Carolina, for example, are found fossil teeth of sharks that must have belonged to specimens having length ranging as high as eighty or more feet. Sharks of this size would have no trouble in swallowing a horse entire, and probably his rider along with it. In 1864 I was bathing upon Egmont Cay, Florida, when I nearly lost my life from the voracious attack of a huge shark, that was attracted to the place by the barking of a little dog that belonged to a companion, who was in the water with him at the same time. While sailing in the Gulf of Mexico I have seen these great sharks about the ship for days, and when the sailors would occasionally catch one, the contents of the stomach of the creature were often most extraordinary. I have an account before me wherein it says, "in one case the contents of a lady's work-basket, even including the scissors, were found," and in another an entire bull's hide. Upon the latter a sailor remarked that the fish had swallowed a bull, but could not digest the hide. Another writer says, "I was holding the heavy hook and wire rope over the side, when I felt that I had caught a big fish, and pulling it cautiously, a shark came to the surface. I called out for help. He struggled so violently, lashing the water with his tail and trying to bite the hook asunder, that we were obliged to keep dipping his head under water and then haul him up two or three feet to let it run down his throat. At last he was nearly drowned, when, sending a running bow-line down the rope by which he was caught, and making it taut under his back fin, we clapped the line around the windlass and turned. Some then hauled his tail up, while all available hands dragged at the other line, which held his head. As soon as we got him on board, he broke off about three feet of the ship's bulwarks by a single lash of his tremendous tail. This was then cut off by the boatswain with a hatchet, while a dozen of us with bowie-knives finished him. We found in his stomach six large snakes, two empty quart bottles, two dozen lobsters, a sheepskin and horns, and the shank-bones, which the cook had thrown overboard two days before. The liver filled two large washdeck tubs, and when tried out gave us ten gallons of oil." The Tiger Shark, and also the great Blue Shark (*Carcharias glaucus*), are also very voracious and particularly dangerous species. I shall never forget something I once saw from the deck of a man-of-war lying in Key West harbor, Florida. The water was very blue, and one could see down into it only a little way. All at once, upon peering into its depths, I became convinced that an enormous brown fish was coming gradually to the surface. As the villain neared it, he became more active, but what fixed my attention most of all, was the curious form of its head. On either side it was produced lateral-wise, the extremity being occupied by the eye. These were large and were rolled about in their sockets in the most horrid manner. It was a specimen of the dreaded Hammerhead shark *(Zygæna malleus)*, and must have been at least between eight and nine feet long, or even longer. This is a very dangerous species, no less so, indeed, than the white and the blue sharks. It is found all along the coast from Cape Cod to Cape Sable, and to the southward. They are also of the man eating variety, and specimens have been captured in the stomachs of which portions of human bodies and plenty of clothing and other objects have been found. There are between twenty and thirty species of sharks and dogfishes found upon the Pacific coast, and many of these have been described by Jordan in his very useful works upon American fishes. The Thrasher and the Mackerel sharks occur upon both of our coasts, and each is a very distinguished species. Oil in considerable quantities is procured from the livers of the latter, while of the former Doctor Goode says that it is known " in Europe as the Fox shark, and to our fishermen most usually as the Swingle-tail. It is one of the most grotesque of sea animals, the upper lobe of the tail being exceedingly long, curving upward and resembling in form the blade of a scythe." Thrashers grow to become fifteen feet or more in length, and weigh several hundred pounds. Stories about their attacking whales, however, have no foundation in fact. Fishermen say they kill fish by blows of their powerful

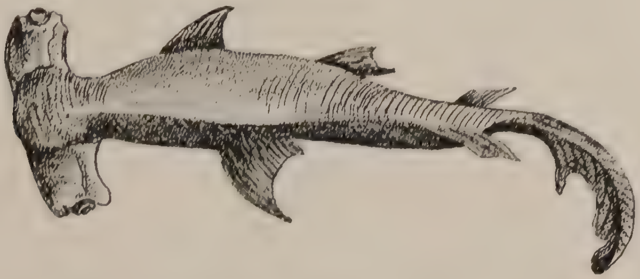


FIG. 12. HAMMERHEAD SHARK (*Zygæna malleus*).

tail, a questionable statement, though it is known that these sharks feed upon fish.

Most of the sharks are viviparous, but the dogfishes produce eggs closely resembling those brought forth by the rays. When a boy, I frequently found them at low water on Long Island Sound, tangled up in the salt water grass. Some sharks are bottom-loving species, while a few species may almost be reckoned among the so-called deep-sea fishes. Two small species of dogfishes have been taken at depths varing between 400 and 500 fathoms, or nearly 3,000 feet below the surface. Gunther says these sharks were from three to four feet long, and "on being rapidly withdrawn from the great pressure under which they lived, they were killed, like other deep-sea fishes, under similar circumstances."

Some naturalists claim that the oldest existing type of vertebrate is a shark. It comes from Japan, and only two specimens of the species have thus far fallen into the hands of science. One of these is in the Museum of Harvard College, and the other is in the British Museum. Our distinguished countryman, Mr. Samuel Garman, of Harvard, was the first man to describe this remarkable shark, and he gave it the scientific name of *Chlamydoselachus anguineus*. A few years ago I received from him a copy of his memoir on the subject, and I have copied his figure to show the appearance of the fish here. (Fig. 13.)

As I have just said above, some of our sharks may almost be classed among those oceanic forms of fishes, that living so far beneath the depths of the seas are now universally termed by naturalists the deep-sea fishes, and by the aid of our modern oceanic dredging machines we are coming to know something of these remarkable forms. Many invertebrates are also thus taken, but after all it is the extraordinary types of fishes that from time to time have come to light which have possessed the keenest interest for the ichthyologist and marine naturalist. Many of these have long been known, but a few years ago the splendid researches of the British *Challenger* expedition greatly increased our knowledge of them. Ingenious nets and trawls have brought up, from depths varing from 200 to 2,400 fathoms, many genera and species of these curious fish, representing, as they do, some dozen or more families. As a fathom is six feet, this means from 1,200 to 14,400 feet, a fact in itself sufficient to excite our wonder. Most all the great oceans and

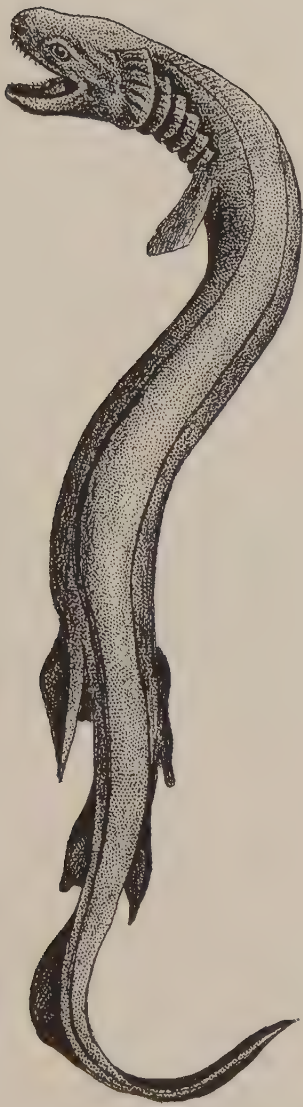


FIG. 13. *Chlamydoselachus anguineus.*

(The oldest type of existing vertebrates.) Drawn by the Author after Garman.

seas have thus been examined, and in all such life is found to be present. These fishes normally never come to the surface, and when forcibly brought up in a trawl, they are visibly affected in a number of ways. Some become greatly inflated by the expansion of the gases within them, and where they possess scales of any size, these are elevated all over the fish's body. Some of these deep-sea forms are found to be blind; a number are semi-transparent; others have peculiar phosphorescent organs on the head; while nearly every one is extremely peculiar in form, great variance is seen to obtain with them (but this has no relation to either latitude or temperature); and in the case of not a few their geographical ranges are very wide—the same species occurring in many parts of the world. Notwithstanding that this is true, some of these deep-sea fishes are very rare. I have in mind at least one instance at the present writing where but a single individual of a certain species has fallen into the hands of science. This was taken years ago by my friend, the distinguished Cuban naturalist, Don Felipe Poey (1872), and sixteen years afterward I published an illustrated account of it—giving a figure of the fish and a description of its skeleton. During all that time no other specimen had been obtained, and so far as I am at present aware, none have been secured since the appearance of my memoir.

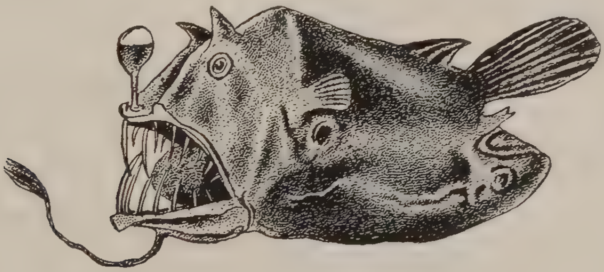


FIG. 14. THE TORCHFISH (*Linophryne lucifer*).
Drawn by the Author.

The "Torchfish," of which I give a figure above, is one of the most remarkable types that has thus far been captured. From its nose there stands erect upon a stem a small organ, elliptical in form and phosphorescent in function, which the fish has the power of making very luminous or the reverse, at its pleasure. The Torchfish also has an elongated and slender filament swinging from beneath its lower jaw. Its free end is tufted. Now, small fish are both attracted by this freely moving little bait, as well as by the beautiful light emitted by the "torch," and darting after the former by the aid of the latter they very freqently land in the capacious mouth of their allurer, who quickly devours them. The physiology of this phosphorescent organ is, as yet, not fully understood.

Very large eyes sometimes characterize certain species of these curious beings, and, as I have said above, sometimes the eyes are absent, or so small as to be detected only after careful search with the microscopic lens. This is the case with the little deep-sea fish form known as the "Blind Angler" (*Mancalias shufeldti*), described in 1883 by the eminent ichthyologist, Dr. Theo. Gill, of the Smithsonian Institution, and obtained at 2,400 fathoms by the United States Fish Commission Steamer *Albatross*. In remarking upon the species, Dr. Gill has said, "they have a real fishing rod, and three of the types have a notable one. The rod is represented by the first spine of ordinary fishes, which is situated on the back part of the head; it is long and borne aloft, and in the typical species rod and line are developed. The rod is represented by the basil joint, and the line by the distal one; the rod is stiffened, but the line quite flexible, and at its end there is a bait in the form of a bulb, whch is generally more or less pyriform in outline. The fish doubtless lies on the ground, carrying the rod curved over its head, and other fishes are attracted by the bulb, which may be moved to and fro; when the incautious inquirer approaches near enough the angler rises upward and engulfs him in his capacious maw. The mouth, be it observed, opens upward, and even to a slight extent backward, and is thus eminently adapted for its angling life."

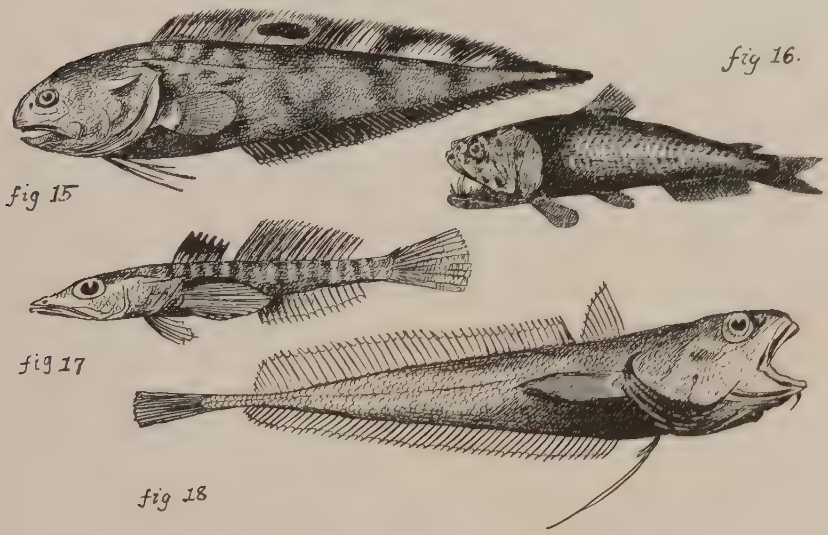
This genus of fishes belongs to the Ceratiids, and are related to another group also known as "Anglers," of which the very well-known and large-sized "Goose Fish" belongs *(Lophius piscatorius (Lophiids)*.

Mancalias was first obtained by the *Challenger* expedition, near the Cape Verde Islands in 2,400 fathoms of water. This was *M. uranoscopus*, the type of the genus; the specimen, 3¼ inches long, is now in the British Museum. *M. shufeldti*, originally described as *Typhlopsaras shufeldti*, was subsequently referred to this genus.

We now have out a very fine work on all the deep-sea fishes.

by no less a distinguished authority than the late Professor G. Brown Goode, the lamented Secretary of the United States National Museum. It is fully illustrated, and covers the entire subject up to the date of its appearance.

During the season of 1892-93, H. M. Marine Survey Steamer *Investigator*, Commander C. F. Oldham, R. N., commanding, with a corps of naturalists aboard, did some good collecting in the Bay of Bengal and adjacent waters. In addition to other forms, the deep-sea fishes collected by them were described by my esteemed correspondent, Mr. A. Alcock, Superintendent of the Indian Museum of Calcutta, India, and he has sent me a copy of the work, wherein the deep-sea fishes appear. It is illustrated by plates, and the drawing used in the present article is taken from a free sketch made by myself of his fishes, and, although not what might be called absolutely accurate in minute details, it nevertheless gives a very good idea of those types as found in the Indian Ocean, or Bay of Bengal, at depths varying from 128 to 573 fathoms. It will be observed that these figures teach us one great truth in regard to such matters, which is probably applicable to all forms of oceanic life—and that is, and we now refer



DEEP-SEA FISHES OF INDIA. (After Alcock.)

Fig. 15. *Neobythites steatiticus*, n. sp. length of type, 5.25 inches. Bay of Bengal, 128 fathoms.
Fig. 16. *Odontostomus atratus*, n. sp. length 3.5 inches, Bay of Bengal, 573 fathoms.
Fig. 17. *Bathypercis platyrhynchus*, n. gen. et. sp. length 4.3 inches, Bay of Bengal, 128 fathoms.
Fig. 18. *Physiculus argyropastus*, n. sp. length 9 inches, Bay of Bengal, 128 fathoms.

to fishes, the nearer we obtain them to the surface of the sea or ocean, the more do they come to resemble, both in form and structure, what we see in ordinary fishes of the shallower waters. All four of the forms shown in the figures belong to new species, and in one case to both new genus and species (Fig. 15). This latter is of the order *Anacanthini* of the family *Ophidiidæ*, it being in the genus *Neobythites* of Goode and Bean, and has been called by Mr. Alcock *N. steatiticus*. To the order *Anacanthini* are also referred the cods, the haddocks, the ling, and similar fishes *(Gadidæ)*, also all the so-called "Flatfishes" and their kin, as flounders, soles, and halibuts *(Pleuronectidæ)*, and other families.

To me, the fish shown in Fig. 15 superficially resembles the common torsk of Europe (*Bromius vulgaris*), which last is not only an Anacanthid, but also one of the cod family, a *Gadoid*. Fig. 16 represents a small, very black fish which was taken at nearly 600 fathoms, and consequently more closely resembles some of the forms coming from still greater depths. Especially is this true of its gaping jaws and long, slender teeth, as in the "Torchfish." *O. tratus* (Fig. 16) belongs to the order *Physoitomi*, and the family *Scopelidæ*. It has no scales, and is supposed to possess rows of small luminous organs on the inner border of the lower jaws and elsewhere. Fig. 17 represents a very interesting little deep-sea fish (order *Acanthopterygii*, fam. *Trachinidæ)*, being of the same great group to which so many of our common fishes belong, as the perch *(Percidæ)*, the mackerels *(Scombridæ)*, the mullets *(Mugilidæ)*, and a perfect host of other families.

Fig. 18 is a fish that belongs to the same order as the species shown in Fig. 15, and to the cod group *(Gadidæ)*, to which, as I have said above, the latter is related. This is rather a large type, of peculiar form and color, being a light pinkish-brown, with a silvery sheen, the belly, throat, and gill membrane being a deep black.

As time goes by, we may look with great confidence toward the taking of still more remarkable forms from the ocean's depths, and even at still greater distances below the surface. This will not be done upon any great scale, however, until the United States Government takes the matter in hand, and sends to sea a fully equipped expedition, with every modern appliance and facility aboard, and a select corps of working naturalists to undertake the explorations to be made. Such an expedition should occupy at least five years in foreign research, and be prepared to carry its surveys far inland, should opportunities arise.

CHAPTER VI.

SEA-HORSES AND EELS.

(Hippocampidæ: Anguillidæ.)

IN the present chapter it is my intention to briefly notice the typical representatives of two very different and only remotely allied orders of fishes. I refer to the Sea-horses and the eels, forms that have for years excited popular interest, inasmuch as the first-named appear so very unfishlike, and the latter by many are suspected of having some sort of kinship with the snakes. Both are teleostean fishes, however, and according to Jordan, the Sea-horses belong to the order *Lophobranchii*, and the Eels to the order *Apodes*.

Again, sea-horses are contained in the family *Hippocampidæ*, genus *Hippocampus*, and Jordan gives two species as occurring in our fauna, viz.: *H. heptagonus* and *H. ingens*. The other lophobranch family associated with them are the pipefishes *(Syngnathidæ)*, of which there are a number of forms on our coasts. They are very different appearing as compared with the sea-horses, as they are small, slender, elongated fishes, covered with bony plates. They have long *non*-prehensile tails, commonly provided with a diminutive caudal fin. The males have egg-pouches, into which the eggs are received and hatched. After this the pouch opens and the young escape. Our United States pipefishes belong to the genus *Siphostoma*, the common pipefish being *S. fuscum*, which is found upon the Atlantic coast.

The Australian sea-horse also occurs in Europe, and according to Goode, "there have been only one or two instances of the capture of this fish north of Cape Cod; one was seined with a school of mackerel on George's bank in August, 1873. Two or three specimens have been taken at Wood's Holl during the last ten years, and instances of their capture in Connecticut and about the mouth of the Hudson are not rare. On the New Jersey coast and south to the Gulf of Mexico it appears to be very abundant." Seen upon lateral aspect, the upper half of the sea-horse is apt to remind one of the piece in a set of chessmen called the "knight," and it is impossible for one not to be struck by its extraordinary equine physiognomy. The lower half of the body is composed of the long, tapering, prehensile tail, which is of a quadrangular form. The body of the fish is much compressed, and it, together with the tail, is overlaid with osseous plates, the borders of which form raised transverse wings, armed with spines or tubercles. The neck is curved, so that the axis of the head is placed at nearly a right angle with the long axis of the body. Spines also ornament the head. It will be seen that the dorsal fin is the largest, while the others are very small. An egg-pouch is present in the male. The mouth is very small, and is found at the extremity of the elongated snout, while the orbits for the eyes are nearly circular. In color, our common sea-horse is of a yellowish brown, darker dorsally. Some small pale spots are found upon the sides, with the cheeks showing light brown lines of a radiating character, and wavy.

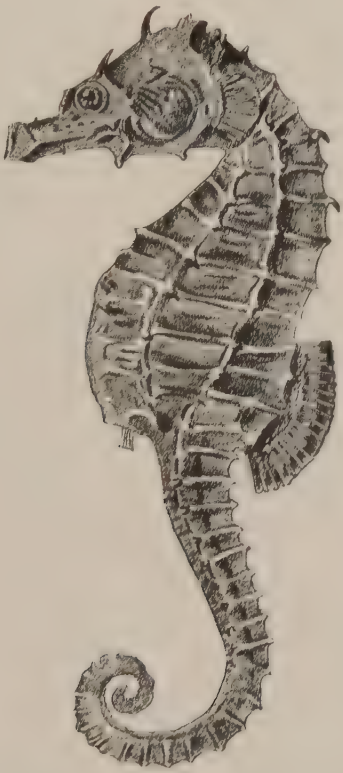


Fig. 19. The Sea-horse (*Hippocampus heptagonus*).

By the Author, after Goode.

Hippocampus ingens, our Californian species, is said to reach a length of nearly a foot, and the form of the body is rather slender. It is of a darker brown than *heptagonus*, being mottled with a still darker shade, and spotted over with white.

Owing to the imperishable nature of the external body armor of a sea horse, many specimens of these fishes float ashore, and in the curiosity shops there is no trouble in securing dried specimens.

Here we may incidentally remark that, although the open seas of the warm regions of the globe are the places where sea-horses are found in the greatest abundance, they are frequently carried by ocean currents to great distances.

In studying a living specimen of the common sea-horse in an aquarium we note that it moves about in nearly a vertical attitude, and that with no great powers of locomotion. Its fins are kept in a state of rapid vibratory action, and it is due to this lack of inherent propulsive power that the fish is unable to withstand the various forces of its element which are brought to bear upon it, such as the ocean currents, and the action of the wind and the waves. By means of its prehensile tail it instinctively clings to sprays of seaweed, bits of broken shells, or anything of a similar nature which may happen to occur in its way.

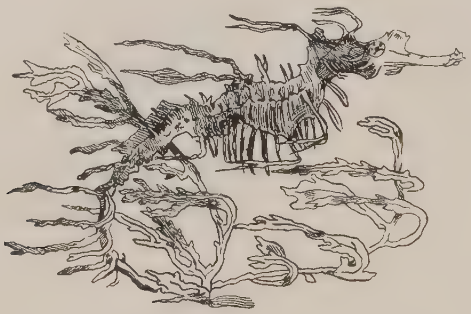


FIG. 20. *Phyllopteryx eques.*
By the Author after Günther, and reduced.

Their peculiar mode of reproduction especially attracts attention to these fishes, "a trait so strange," as Lockwood has said, "as to suggest the seemingly abnormal habits of the marsupials —the opossum and the kangaroo—although the eccentricity of the fish is far greater than that of the land marsupial; for, in the latter, it is the female whose pouch receives the immature young, and which are therein nourished to complete their development. The parental relation of the female lophobranch, however, is restricted to the simple emission of the unimpregnated eggs. Beyond this, maternity she has none. The male is really father and mother to the progeny."

The baby sea-horses measure about five to six lines in length, and notwithstanding their thread-like and rounded tails, with their semi-globular heads and short, wide snouts, there can be no mistaking their parentage. At the very outstart, too, they are in full possession of their little whip-like caudal appendages, and they will, in passing each other, mutually extend them for a common intertwinement, resulting in both the owners coming to a standstill as they pull away in opposite directions. A more enterprising member of the host may vary the program by curling its tail about the stumpy muzzle of some one of its numerous brothers or sisters, and, for a moment, literally lead its captive relative about by the nose. It is said that there is no end to the amusing antics they perform.

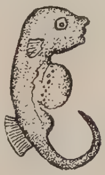


FIG. 21. FRY OF SEA-HORSE.
By the Author, after Lockwood.

"In the matter of fœtal sustenance," says Lockwood, "I find a remarkable marsupial analogy in the hippocampus. The pouch of the kangaroo and the opossum contain teats, with which, by true lactation, the young are nourished until fully formed. Nor is the embryonal sack of the sea-horse a mere receptacle for the hatching of the eggs, as nourishment is supplied to the growing young. We know that the bear, during hibernation, lives upon the fat acquired the previous season. During a journey that requires abstinence from food, the well-conditioned camel will subsist on the absorption of its fattened hump. The tail of the frog, which has just completed its last metamorphosis, does not pass off by atrophy, but is really a wise provision for the creature's support by absorption during the few days which constitute the most critical period of its life."

One of the chief protections sea-horses have against their enemies is the way in which their coloration, as a rule, harmonizes with their surroundings. This protection is still further enhanced by the very form and attitudes of the fish, and by the wavy dorsal fin, and peculiar spines and tubercles which project from its head and body. This protective mimicry is perhaps best seen in the remarkable Australian sea-horses, which belong to the genus *Phyllopteryx*, an example of which is shown in Fig. 20 of this chapter. Here the loose, floating appendages of its body have more the appearance of sprays of waving sea weed than they have to anything which ought to belong to a fish. It is a very singular sight to dip up a bucket of sea water containing a quantity of sea weed of a certain species, and come to examine it; for at first no one would suspect the presence of such a thing as a fish. But presently there floats away from the vegetal mass, weakly swimming, a specimen of these truly extraordinary lophobranchian creatures, which for all the world resembles a thin bit of scraggly root, with the loose and undulating sea weed clinging to it. This proves not to be the case, however, for it is nothing more nor less than a *Phyllopteryx* we have before us, which, as Günther has very truly said, is "one of the most singular types of littoral fishes."

It is thought in the case of the young of the pipefishes that they re-enter the pouch of the parent when threatened with any danger, but this has not, to my knowledge, been proved to obtain with respect to the fry of *Hippocampus*. When the male sea-horse once rids himself of his descendants, he ceases to entertain, as a rule, any solicitude for them, and it must be thought that the mother of these helpless little animals hardly knows, or actually does not know, what they even look like. Strange to say, nevertheless, the male sea-horse has been known to vigorously protect his brood of young shortly after their escape from his brood-sac, and instances are upon record of his doing this in the case of an attack upon them by the female, unconscious as the latter probably was that they were her own. Had she succeeded in devouring them, however, she would have accomplished no more than do some other species of fishes which are known to feed upon their own fry.

Considering next certain representatives of the family *Anguil-*

lidæ, it may in truth be said that there are vast numbers of people who believe that our common eels are, as I have said above, nothing more nor less than some kind of a water snake, and in reality related to the true serpents. This opinion is entirely an erroneous one, and eels are not only not snakes, but they are not even akin to them. They are a family of apodal *fishes*, numerous forms of which, to some extent, resemble a snake in appearance, from their having a general serpentine outline.

It is quite remarkable to find persons possessing a high order of intelligence in many fields of information to be almost entirely ignorant of such matters.

There has been since the days of Aristotle an enormous literature devoted to the subject of eels, the structure of both sexes, and their habits and reproduction. The geographical distribution and migration of eels have also received very considerable attention, the latter being a subject of special interest. One of our best authorities on fishes, Dr. D. S. Jordan, recognizes but one species of common eel occurring in this country *(Anguilla rostrata)*, which he says is "very abundant from Maine to Mexico; ascending all streams, and resident throughout the Mississippi Valley. Also recorded from China." On the other hand, Dr. Goode assumes the specific identity of the eels of the Old and the New Worlds, and makes the habitat of the common eel almost cosmopolitan, designating the species as *A. vulgaris* (Fig. 22). Still other authorities entertain views at variance with the two just given, and Prof. Packard, one of our best known naturalists, says " the common eel," which he claims to be " *Anguilla acutirostris*, occurs on both sides of the Atlantic, on the North American coast as far south as Cape Hatteras, and in inland rivers and lakes." From this it will be admitted that not a little yet remains to be accomplished, even in the matter of the correct identification of the members of this genus.

One of the most interesting facts connected with the history of eels is that they are known at times to leave the water and to pass over dry land to other ponds or lakes in the neighborhood. By the aid of roots and branches or inequalities of the ground, they have also been known to climb out of the water and up more or less steep ascents, sometimes to the height of twenty feet. When confined in ponds, eels will often quit these at night, and squirming over the moist meadow-lands or the dewy grass, pass to a river in the vicinity, where they may enjoy purer water and better conditions.

A great many interesting incidents might be told bearing upon this chapter of the life-history of these remarkable fishes. Many and peculiar have been the theories in regard to the reproduction of eels. Originating probably with Aristotle, the idea was long entertained that they sprang from mud; later they were supposed to be bred in the ground; some believed eels to be viviparous, and even to-day it is not difficult to find those who will contend that young eels are produced from the hairs of the tails of stallions that have been deposited in the water. Sharp indeed, in times past, have been the disputes upon this question, but it is now firmly established that, agreeing with other teleostean fishes, they are oviparous, and have, like them, a milt and roe, which, though differing considerably in appearance, nevertheless functionally fulfill the same end. Eels deposit their spawn in sand or mud in brackish water at the mouths of rivers, and to reach these localities they migrate in autumn, down various water-courses, to their spawning beds. This migration is performed only upon the darkest nights, the reverse being the case with the young eels in the springtime, they in their turn passing up the rivers during the day in enormous numbers. In England, says an authority at hand, "this migration takes place from February to May, according to the temperature, and some idea of the vast numbers of young eels which annually pass up our rivers may be formed from the fact that 1,800 of them, each about three inches long, have been observed to pass a given point on the Thames in a single minute."

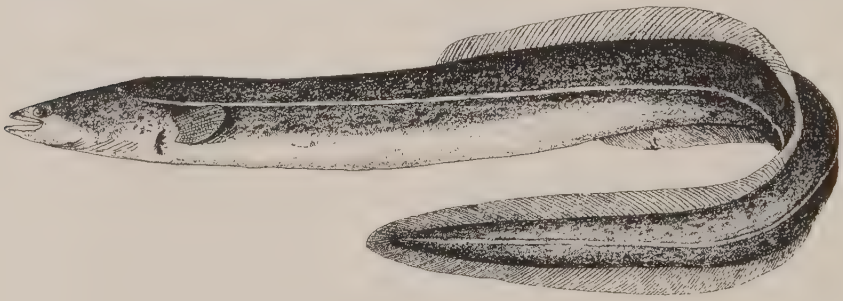


FIG. 22. THE COMMON EEL (*Anguilla vulgaris*).
Drawn by the Author, after Goode, and greatly reduced.

Many points in the history of eels are of interest; their peculiar structure and wherein they differ from their near allies among fishes; of their great economic value as a food, and how some nations eat them and others do not; of their intolerance of cold, and how in the winter time hundreds of them will huddle together in the mud a foot or more beneath the surface, and where fishermen will capture them in great quantities by means of eel spears, especially after the tide has fallen and left them dry.

Baird has said that eels will eat anything, living or dead, and so far as my own personal experience goes, I believe them to stand among the scavengers of the rivers and seas where they occur. They are both carnivorous as well as voracious, and during the summer months of their activity consume thousands of young fishes, worms and larvæ of marine insects.

In ancient times the Egyptians regarded these fishes with the greatest possible disgust, while, on the other hand, the Romans and Greeks esteemed them among the most savory of their dishes, and frequently were willing to pay enormous prices to secure them as a food. It is said that in these days eels are never eaten in Scotland, though in England, as well as in this country, vast numbers of them are annually consumed. The greatest eel-breeding establishment in the world is that at Commachio on the Adriatic, where an immense swamp, bounded and fed by two of the mouths of the River Po, 140 miles in circumference, has been utilized for this purpose. The industry is very ancient, having yielded in the sixteenth century an annual revenue to the Roman Pontiffs, in whose territory it was, of $66,000. The eels are cooked at Commachio and forwarded to the principal towns of Italy.

Among the allies of the common eels we find upon our coasts the muræenas, which belong to the family *Murænidæ*, and of these there appear to be at least three well recognized American species. *M. mordax*, of the lower California waters, is there known by the fishermen as the "Conger eel," or the "Congeree," who dread it on account of its ferocious disposition and the ugly bite it so frequently inflicts. These great marine forms that have been known to attain a length of ten feet, and weigh upwards of 150 lbs.

It is a first-rate food-fish, and much sought after, many of them being brought into the markets at Los Angeles. Another species is the "Speckled moray" *(M. ocelata)*, found from Florida and Texas coasts southward, and finally, we have *M. melanotis* of the West Indian seas, that has been captured on our Atlantic coast. These eel-like fishes often attain a length of five or six feet, and possess the power of striking with their tails, like some snakes. Many species of them are found in the tropical seas, and a great deal of interest has been written about them. The common Mediterranean form is *M. helenæ*, called the "Muræna" by the ancient Romans, who greatly esteemed its white and savory flesh. They kept them alive in vivaria, and Julius Cæsar distributed over 6,000 of these to his friends when celebrating one of his triumphs.

Still another most interesting eel family are the famous electric eels, which come to be five or six feet long, and are common in the marshes of Brazil and the Guianas. We have all heard the story, so well and briefly told by Gibson, who has said that the natives regard this animal "with terror," owing to the formidable electrical apparatus with which it is provided, and which extends along each side of the lower portion of the tail. When this natural battery is discharged in a favorable position, it is sufficiently powerful to kill the largest animal; and, according to Humboldt, it has been found necessary to change the line of certain roads, owing to the number of horses that were annually killed in passing through the pools frequented by the gymnoti. These eels are eaten by the Indians, who, before attempting to capture them, seek to exhaust their electrical power by driving horses into the ponds. By repeated discharges upon these, they gradually expend the marvelous force; after which, being defenseless, they become timid, and approach the edge for shelter, when they fall an easy prey to the harpoon of the Indian. It is only after long rest and abundance of food that this fish is able to resume the use of its subtle weapon.

CHAPTER VII.

FROGS, TOADS, NEWTS, AND OTHER AMPHIBIANS.

(Class *Amphibia.*)

AS distinguished from the Class *Reptilia*, which contains the turtles, tortoises, snakes, lizards, crocodiles, etc., the Class *Amphibia* is made to contain such groups of amphibious animals as those arrayed under the *Urodela (Siren, Proteus, Menobranchus, Amphiuma, Menopoma*, and *Cryptobranchus)*, the *Anura* (as frogs, toads, hylas, etc.), the *Peromela (Cœcilia*, etc.), and the *Labyrinthodonta* (fossil forms).

In the fauna of the United States we have many of this Class of the *Vertebrata* represented, as for example we have among the *Urodela*, the Siren *(Siren lacertina)*, the Proteus *(Necturus)*, the Congo snake *(Amphiuma means)*, the Three-fingered siren *(Murænopsis tridactylus)*, the Hellbender *(Menopoma)*, a great many salamanders *(Amblystoma)*, a host of tritons and their allies *(Plethodon*, etc., etc.); while among the *Anura* we have all the frogs *(Rana*, etc.), the toads *(Bufo*, etc.), and the Tree frogs (*Hyla*, etc.).

During the last fifteen years many of these forms have been treated by me in a variety of publications, but it is evident that in a brief chapter like the present one it will be quite out of the question to do more than to briefly refer to some of the better known United States *Amphibia*, and thus incite the reader to carry his investigations further, and consult other volumes upon their life-histories. As I have said in another chapter, we stand very much in need of exhaustive and recent treatises upon both the *Reptilia* of this country, as well as the *Amphibia*. Nearly or quite all of our systematic works upon these subjects are now antiquated. Professor Cope, at his death, left the manuscripts for a fine volume treating of them, and I presume, sooner or later, it will be published by the United States National Museum, but just how much of the ground it will cover I am at this writing unable to state.

A good many years ago I had the opportunity to study a very good representative of one branch of the *Urodela* group, at New Orleans, Louisiana. It was the Three-toed siren, there called, in common with another form, the Congo "eel." My species, however, was *Murænopsis tridactylus*, while *Amphiuma means* is more properly known as the Congo eel among the people in the regions where it occurs. Still both *Murænopsis* and *Amphiuma means* bear this name among the negroes and less intelligent people of the South, who also call them "lampreys," and dread them as they would rattlesnakes. Of course they are in no way whatever venomous, but they will bite. A small one, which I kept in a tank of water, if roughly handled, would curl up, slowly open his mouth, and make an awkward longe at the fingers or hand that held him. Sometimes he would only open his mouth and hiss in a subdued manner. On one occasion, however, this reptile succeeded in getting out of his tank during the night, and when I found him in the morning, in a distant part of the room, he snapped at me quite savagely several times before he was retaken.

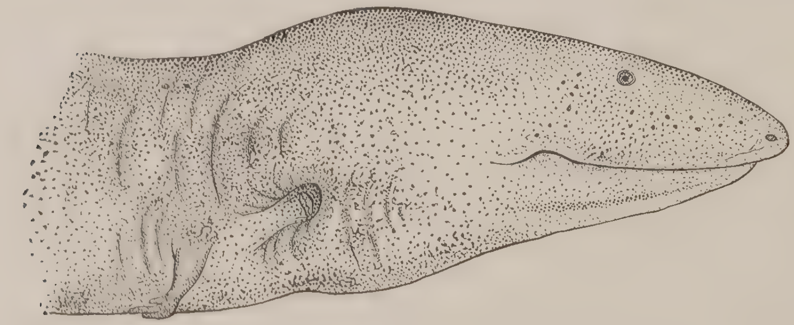


FIG. 23. LIFE-SIZE HEAD OF *Murænopsis tridactylus*. Adult.
Drawn from the living specimen by the Author.

It was interesting to observe his method of leaping out of his tank of water, which by seven or eight inches was not full. He swam round and round with increasing rapidity till the necessary impetus was acquired, when he would prettily make a sort of a spring over the side of the tank on to the floor, where he would squirm round like an eel until replaced. In such situations he uses his feeble legs to the full extent to which they seem capable of being put; in the water, too, these members are constantly brought into use, the fore-pair when he desires to move very slowly forward, in which case he may or may not, generally not, use the hind pair in aiding the action. The fore-pair are also used alternately to push himself one way or another, when he wishes to change his course. A common use for the hind-pair is to throw them forward and brace them against the ground he may be passing over, in order to check his onward movement, either partially or entirely. In swimming about he has all the appearance of the common eel ; and during these times he draws both pairs of limbs close beside his body, when his action is graceful and interesting to behold.

When these sirens are at rest they either stretch out in gentle curves, sluggishly along the bottom, or, what is not very uncommon for them to do, curl up tightly, in a spiral manner, the latter two-thirds of their length, while the head and remaining third is protruded forward in a direct line. In this curious position they float near the surface, the head being lowermost. If two occupy the same vessel they often curl about each other in rather an affectionate manner ; but I have never witnessed them quarrel or fight. One time I threw a dead king-snake into the tub of my first small specimen, the snake being at least three times as long as the siren. Imagine my surprise to see him fly at the intruder, seize him just below the head, straighten out as stiff as he could, then rapidly whirl round, as a drill does, causing the dead snake to be spirally coiled about his body. A moment of quietude followed this strange maneuver, during which time one could see a crunching movement on the part of the jaws of the siren going on ; but, finding his enemy showed no resistance, he slowly let go his hold, and, freeing himself from the dead snake's coils, swam about the tank without paying him any further attention. In a few moments, however, I repeated the experiment, when he made the same attack with just as much vigor as before ; but all subsequent trials failed, and I could never induce him to take further heed of such a harmless enemy.

This siren will eat crayfish in confinement ; but I never could induce one to take anything else, although raw meat was the common bait used by the negroes in catching them for me. Sometimes before a meal, or maybe after, your captive will swim gracefully about his limited quarters, and occasionally rise to the surface, stick his nose out of the water, and give vent to a loud, blowing sound, that may be heard anywhere in a large room, even if conversation be going on. As already remarked above, my collectors usually took such specimens as they brought me. with the ordinary hook and line, baited with fresh meat ; but very often they are captured in hand dip-nets, or even thrown out of a shallow drain or bayou with a stick. They are most often seen after heavy rains, when their usual places of resort are flooded over. Usually when taken they are at once dispatched and wantonly mutilated, so great is the detestation in which they are held by the people of the South. They are extremely tenacious of life, and may be cut all to bits, and still move after the lapse of half an hour.*

Before passing to the consideration of the next group, I would say that many recent writers place both of the *Urodela* noted above, in the same genus as *A. means*, the Two-fingered, and *A. tridactylum*, the Three-fingered siren; the latter being the species I have described. We stand much in need of full descriptions of the life-histories and morphology of our other United States *Urodela.*

If now the question be asked, What is a salamander?—that is, the representative of the next group of these *Urodela*—it may be said that all sorts of opinions in history, both past and present, have been entertained as to what the nature of a salamander is. Aristotle, who wrote when science was comparatively in its infancy, believed that there were some animals so constituted that they were incombustible. In proof of this he cited the salamander, which, " when it walks through fire, extinguishes it." Ælian, too, evidently believed this to be the case, and although he is careful to state that salamanders are not born of fire, nor is that their natural habitat, yet when the bellows of the forger fails to quicken the flame on his forge, there is a salamander near, and the only remedy is to find and destroy it. Pliny, another sage of early time, firmly declared that the saliva of a salamander applied to any part of the body whatever would cause the hair to fall out ; consequently we find Dioscorides referring to prepared salamander oil to be used as a depilatory. According to Pliny, too, the salamander was of cold complexion, and had the power of emitting a cold, venom-like aconite, but of such a virulent nature that it poisoned the wood of trees over which the animal crept, and bread baked with such timber would kill whoever ate of it. What was mythical and fabulous in the writings of the early authors, passed down with medieval history as actual beliefs—beliefs strongly impregnated with similar absurd-

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*In *Science* (Vol 2, No. 27, Aug. 10, 1883, pp. 159–163), I have given rather full notes upon the anatomy of *M. tridactylus*, with still more on its habits than I am enabled to present here. Its skull and other parts of its skeleton are also there figured.

ities. This is seen in that remarkable work of the time, the *Physiologus*, which still taught that a salamander could quench fire. But the Arabic *Physiologus* taught that it was a stone that possessed that property. Later, asbestos proved to be the stone in question, asbestos was the salamander of Marco Polo, and a kind of incombustible cloth was manufactured from its fibers. Thus the Arabs, who knew not whether a salamander was beast or bird, and in some way mixed it up with the Phœnix, came to believe that asbestos cloth was made either from the feathers or else the hair of a salamander. So Bacon and some other writers of his time called asbestos salamander's wool. Cabalistic moderns refer to the spirits of fire as the salamanders of that element, and it is by no means uncommon even to-day to find people in plenty who still have the salamander myth in their minds, and will innocently ask if such a creature does not really exist, and possess the power to pass unharmed through an ordinary fire, quickly. I know a captain in our army whom I never could convince that those spiny-coated lizards of the west, popularly known as "horned toads," were not "some kind of a salamander, or a crustacean, that could pass unharmed through the flames of a camp-fire." And another officer of the same regiment, more open to conviction, had his mind disabused by me of the belief it had, that larval salamanders and the famous "Gila monster" were one and the same animal, and that their "breath was poisonous," and would cause certain death to the person who unfortunately happened to breathe it.

In Europe, from the very earliest times down to the present day, all the tail-bearing amphibia were considered by nearly everybody to be salamanders, and consequently popularly associated with the mythical creatures so named by the ancient and medieval writers.

Over a century and a quarter ago, or in 1768, a naturalist by the name of Laurenti designated a genus of vertebrated animals of the Class *Amphibia*, as the genus *Salamandra*, and to this genus biologists now restrict all the typical forms known to us as salamanders. They are most interesting creatures to study, and it is hardly necessary to add that they are not possessed of any of the remarkable powers which the writers of the middle ages, and both before and since, would have us believe.

Taken in connection with what has been pointed out above, it may be said that the *Salamandrida* is a subgroup of the

Urodela, and it is in its first division, the Mecodonta, that we find, among numerous other genera, the genus *Salamandra*.

Salamanders are found distributed very generally over nearly the whole of Europe, especially the central and southern parts, and they occur also in Syria and in Algiers. Great Britain, or the British Isles, lacks them entirely, nor are the salamanders found in the fauna of the United States. These truly harmless little creatures secrete themselves under the debris of the forest, in damp and shady localities, where they feed upon numerous kinds of insects and worms. They are viviparous, the thirty or forty eggs of the female parent developing in the oviducts at one time, and the young when born being deposited in sluggish, stagnant water, where they live and grow for some time. To the biologist the development of the young of the salamander offers a chapter in science of great interest and importance, as they pass through a series of stages, or a metamorphosis of a very instructive nature. Neither physiologically nor structurally are they for some time as high in the animal scale as the parent animals. In other words, among other things, they possess external feather-like gills, and consequently are comparable with the adults of a group of creatures lower in the scale of creation than *Salamandra*—I refer to the *Perennibranchiata*.

I have said that we have no true salamanders in the United States, but what we do have, are a number of genera of amphibians, the representatives of which are more or less nearly allied to *Salamandra*, and of these genera, the genus *Amblystoma* is especially rich in forms, being variously distributed all over the country.

Some naturalists have fallen into the habit of calling them salamanders, and in reality in external appearance one of our American "Elfs" or amblystomas closely resembles a continental salamander. Like the latter, the young pass through a "tadpole stage," and a "perennibranchiatal stage," before assuming the adult form. In the latter condition they live in the fresh-water pools, have four limbs, and breathe by gill-slits, that possess feather-like external gills. To better appreciate the appearance of the adult of one of these creatures, I submit here a drawing of our "tiger salamander" *(Amblystoma tigrinum)*, made from a photograph that I succeeded in obtaining in New Mexico. During the aquatic existence of one of these amblystomas they are known in Mexico and Southwestern United States as the

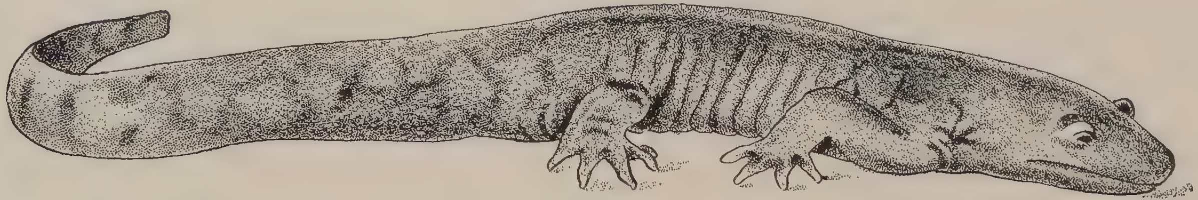

Fig. 24. The Tiger Salamander.

Natural size, from a photograph by the Author.

axolotl, what Cuvier, the great French naturalist, for a long time thought to be an elf tadpole. He was the more certain of this, inasmuch as they can in this immature stage reproduce their kind! Axolotls were even referred by naturalists to a different genus—*Siredon*, and were there retained for a long time. Some of them were kept and studied with great interest in aquaria at the Jardin des Plantes, at Paris, and it was here, to the astonishment of all, that their true nature was revealed. Without any apparent reason one of the specimens one day suddenly was transformed into an adult amblystoma, and the fact threw a flood of light into the natural history of the entire group. Since that time they have been studied by biologists all over the world, and the writer of the present work had an excellent opportunity to gratify his own tastes in that direction during a sojourn in New Mexico for a period of five years. Through the Smithsonian Institution I sent upward of 300 of the living young of the "tiger salamander" (see Fig. 25) over the United States and Europe, where they were very generally distributed in the biological laboratories of the various institutions of learning (see *Science*, Sept. 25, 1885). Fingers and toes, and even more of the limbs of these creatures, will reproduce themselves after having been amputated, and this is also an interesting fact about them.

Personally, I have never examined the Spotted salamander of Europe, but we read that the "body is covered with warty glands, which secrete a milky fluid of a glutinous and acrid nature, like that of a toad, and which, if not capable of affecting the larger and more highly-organized animals, appears to be a destructive agent to some inferior species. Thus Laurenti provoked two gray lizards to bite a salamander, which at first attempted to escape from them, but being still persecuted, ejected some of this fluid into their mouths ; one of the lizards died instantly, and the other fell into convulsions for two minutes, and then expired. Some of this juice was introduced into the mouth of another lizard; it became convulsed, was paralytic on the whole of one side, and soon died. This account is the only foundation for the long-cherished notion of the power possessed by the salamander, and attaching to it the reputation of being one of the most venomous of animals." The same writer asserts that "a copious secretion of this fluid might damp a moderate flame for an instant or two to which a salamander had been committed, and the animal suffer no harm," and this accounts for the other long-cherished myth! Myth and miracle both have their origin in ignorance, and the only radical cure for either affection known to me, is a heroic dose of a full knowledge of the facts pertaining to any particular subject.

A marvelous variety of interesting forms are included in the *Anura*, being represented in this country principally by the FROGS (*Rana*, *Scaphiopus*, *Spea*, *Hyla*, *Acris*, and others) and by the TOADS (*Bufo*); while in other parts of the world both of these groups have a vast number of genera and species, and a third group is found created to contain the Surinam toad (*Pipa*) and *Xenopus (Dactylethra capensis)*. They have been classified upon their anatomical peculiarities, but this classification must still be considered in a degree provisional, until worked out in greater detail and more extensive comparisons made.

The forms and appearances of typical frogs, a Cricket frog, toads and tree-toads, are so well known, even to casual observers, that space will be gained here by the omission of detailed descriptions. The literature upon this division of the *Amphibia* is quite profuse, and the student to gain a good knowledge of the subject should read such books and articles as the very excellent work by Prof. St. George Mivart, F.R.S., on "The Common Frog" (1881); Prof. Huxley's article "Amphibia," in the ninth edition of the Encyclopædia Britannica; Gunther's Catalogue of the Batrachia Salientia; Prof. Cope's numerous works; Mivart's essay "On the Classification of the Anurous Batrachians;" the anatomical contributions of the Parkers, of Owen, of Gegenbaur, of Sabatier, and many other writers. From these one will gain very general information upon the geological history of frogs and toads; upon their general and special structure and habits; their distribution and their classification. All adult frogs and toads, as the name *Anura* implies, are *tailless*, possessing as they do *four* well-developed limbs, and short, squatty bodies, large mouths, scaleless, smooth skins, big eyes; and they may be with or without tongue, and with or without teeth. Many of them habitually live in the water, while others only resort to that element for the purpose of depositing their egg-masses. In the reproduction of young frogs they pass through changes (metamorphoses) corresponding to the development of young fish. Anyone who has studied "pond-life" is familiar with the jelly-like mass of eggs deposited in the water by female frogs, these ova being impregnated by the male at the time of their passage. In due course of time, depending largely upon the temperature, these eggs hatch out the young tadpoles, that pass through various stages to young frogs. These stages are exceedingly interesting to study, and the far-reaching chapter they cover in biology will more than repay the young naturalist who will collect a mass of these eggs, take them home, and, placing them in the proper conditions, watch all the details of the development, with a complete treatise upon amphibian reproduction at hand.

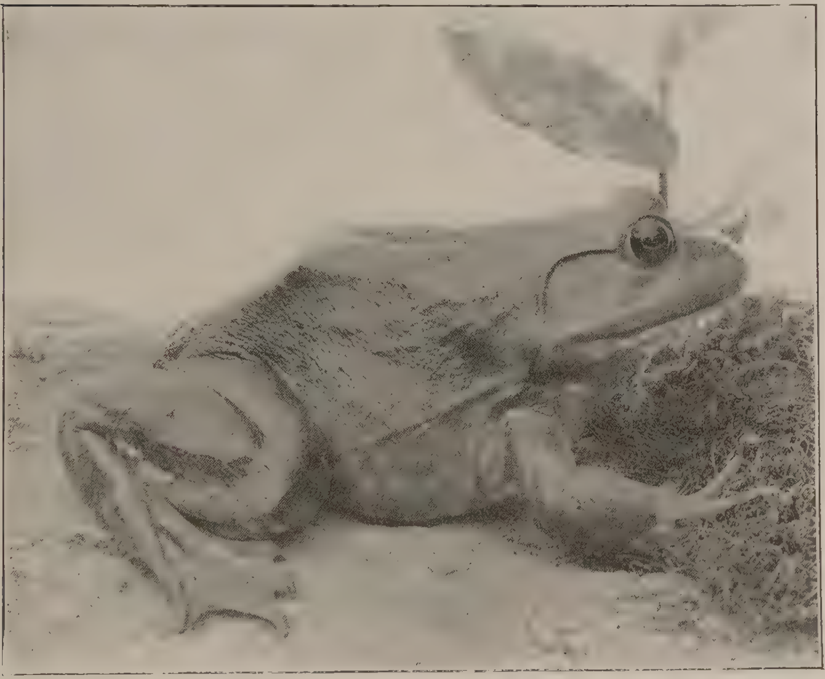

Fig. 25. Common Bullfrog.
One-half natural size. From a photograph by the Author.

Tadpoles of the *Anura* subsist upon a vegetable diet, while the adult frog lives upon insects, crustaceans and the smaller fishes. It is said that our common Bull-frog takes about five years to attain its full growth, and its life is supposed to extend to about ten years more thereafter. They have a host of enemies; as man, and many other mammals, raptorial birds, and snakes and other reptiles. Some fishes also prey upon them.

In the June number of *Appleton's Popular Science Monthly* (1896) I contributed an article, entitled "Frogs and their Uses," it being illustrated by a reproduction of a photograph of our Bullfrog (*Rana catesbiana*) (p. 181), and this figure is given here as one well showing the external form of this species.

Mivart claims a frog to be "a tailless, lung-breathing, branchiate vertebrate, with four limbs typically differentiated, undergoing a complete metamorphosis, and provided with teeth along the margins of the upper jaw." This last character is one that distinguishes the frogs from the toads, while from other batrachians the frogs are at once separated by the absence of a tail. Both frogs and toads hibernate in the winter, coming forth in the spring. The process of development in toads is very similar to that of the frogs, only the eggs are strung out in links instead of being in a mass. These long chains of eggs are drawn out of the body of the female by the hind legs of the male, while she is in the water.

In this country we also have in the Northern and Eastern States one of the best known of all those little arboreal batrachians, vernacularly known as tree-toads, or more properly—tree-frogs, though I will call them "toads" here, because they are so generally known as such. This is the northern tree-toad, or, as it is called by others, the chameleon *hyla*. *Hyla* is the scientific appellation of the genus to which all the true tree-toads have been referred; and our common tree-toad is called *H. versicolor*, from the well-known fact that it possesses the power of varying the shade of its skin. At certain times this little toad is of a very pale ash color above, variegated with marbled markings, while beneath it is nearly white, and the lower and inner sides of the thighs are of a beautiful yellow, with a few darker maculations. From this livery I have seen it slowly pass through a pale olive shade to one of a rich snuff-brown, with the mottlings on the back nearly black, while very little change was to be observed upon the lower parts. This all happened when the creature was placed on a very dark and wet piece of pine bark in a closed jar. An hour later, when I returned to look at him, he, with another individual of the same species, had crept beneath the bark, and were close against the glass, and by this time had assumed the palest possible tint of gray, with the marbling very distinct

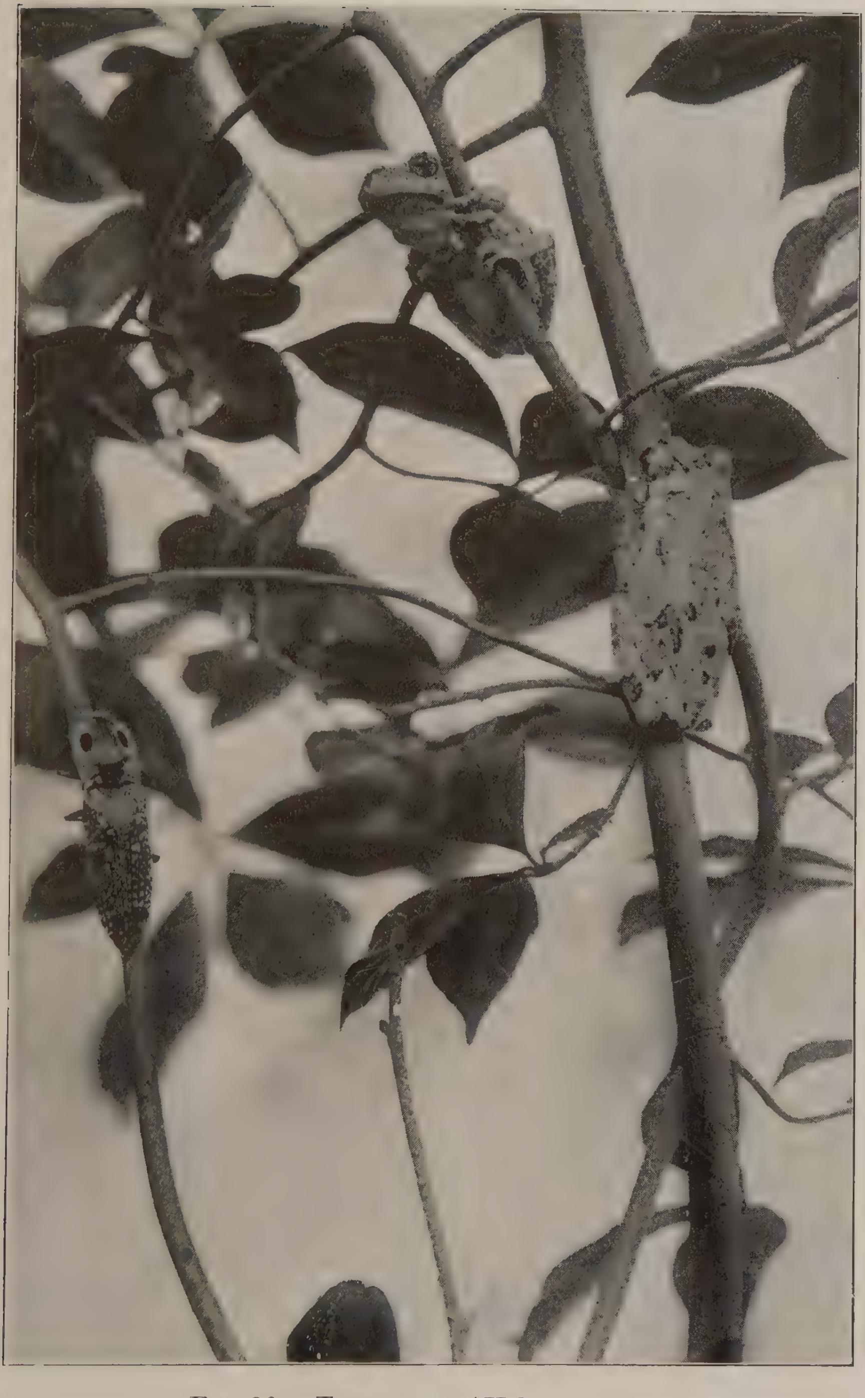

FIG. 26. TREE-TOADS (*Hyla versicolor*).

From life. Photographed by the Author.

again on the back. When one comes to study them closely the eyes of one of these tree-toads are very beautiful structures, as are the eyes of our common toads.

It took me over an hour one summer's afternoon to secure a good photograph of a pair of tree-toads, and I found them far more difficult subjects than many young birds I have succeeded with in half the time. They have a habit of suddenly moving, or even jumping, when one least expects, and as an exposure of half a minute had to be given them, owing to the very small diaphragm used, the task came to be one of great difficulty. One might be easy enough, but two was a contract. Their jumps are of a very extraordinary character, for they can not only spring some considerable distance, but they are able to hit the point they start for with a remarkable degree of accuracy. In my photograph (Fig. 26) the upper specimen is just balancing himself for a leap, and from this attitude he can launch into the air for two or three feet, and with certainty land upon any selected leaf in a tree he may care to, it being no bigger than the leaves shown in the picture. They can also jump to a horizontal place, alighting back downward, and a vertical plane surface gives them no trouble at all to land upon. All this is accomplished by means of the little disk-like suckers on the under side of the ends of each and all the toes and fingers. No doubt the moisture ever present on the under side of the body aids, too, in their sticking to the variously inclined surfaces they alight on in their leaps among the leaves and branches of their haunts.

Frequently, when at rest, a tree-toad will assume the posture seen in the lower specimen of my photograph, and it is when thus resting that they give vent to their peculiar pipings during cloudy or rainy weather. Often I have heard them set up a clamorous chorus in the night time, and they are simply tremendously noisy during the breeding season. Some claim that these tree-toads likewise possess ventriloquial powers, that deceive the ears of those in pursuit of them, but I have relied only upon my eyes to capture all the specimens taken by me. The large, handsome insect in Fig. 26 is a more or less abundant species in the summer time in many localities. Children call it a "knicker," from the contrivance it has for springing or snapping up, when placed upon its back. In science we call it *Alaus ocelata*, the more respectable name, I think, and fully as descriptive.

Tree-toads subsist largely upon various kinds of insects that they capture in the trees where they live. There are about a dozen other species of hylas found in the southern and western parts of this country, while the species now being described is likewise found in the west. On one occasion I remember capturing four large specimens of them in the crevices of the dark moss-covered rocks that inclosed a well-known spring near Fort Wingate, New Mexico. It was marvelous to see how closely their mottled skins matched the rocks upon which they were, both in color and appearance.

These tree-toads will live a long time without taking either food or water; they exhibit but little evidence of inconvenience from such treatment, even after a fortnight, and then if they have access to fresh water they appear as well as ever. Many times I have kept them with the hope of studying their mode of reproduction, but have never succeeded in getting them to breed in captivity.

The history of the true toads (*Bufo*) is full of interest, and would fill a goodly volume. One of their chief characters consists in the large, protuberant warts on their skin, which secrete an acrid fluid, very obnoxious to carnivorous animals, and probably protects them against their attacks. These batrachians have four toes in front and five behind, as in the frogs. On the latter they are joined usually by complete webs of membrane. In speaking of the Common toad of Europe *(B. vulgaris)* a popular writer at hand truly remarks that instances have occurred of these animals having been found imbedded in indurated clay, the solid trunks of trees, and even in rocks, where it was believed they had remained for years, perhaps for ages; yet on being liberated, came fully to life. The general opinion of scientific naturalists is, that these accounts are either untrue or inaccurate. They believe that toads may subsist for a long time, perhaps for years, with very little food or air, and that they may have been found apparently inclosed in solid substances, but that in point of fact there was some crack or crevice through which they obtained air and small insects sufficient to support life.

The "croakings" of toads and frogs are often very remarkable, and, taken in connection with the anatomy of their voice organs, well worthy of study. Shakespeare speaks of the myth of the jewel in the head of a toad, and this is probably founded upon the great beauty of its bright eyes, in which the iris frequently has all the brilliancy of a fine opal or sapphire.

It is interesting to note the method, by the use of its very extensible tongue, how toads capture their insect prey—so different from the frog, that leaps at it with gaping jaws. In fact, there is so much to write about pertaining to these curious animals, that the danger is one's pen may run away with its holder, and so I very reluctantly bring this chapter to a close, and only trust that it may incite the reader to look more carefully into the literature of the *Amphibia* and record, what we much need, fuller histories of our United States forms of them.

CHAPTER VIII.

SOME OBSERVATIONS ON LIZARDS.

(*Lacertilia.*)

WE very much need a complete treatise upon the United States *Reptilia*, fully illustrated, with a companion volume upon the *Amphibia* of this country. No such work has as yet been published, and our herpetologists are, at this writing, still depending upon a literature of the subject, which is rapidly becoming more or less antiquated. Usually, naturalists include in the *Reptilia* a variety of orders of extinct reptiles, as well as the more modern groups of *Crocodilia*, *Lacertilia*, *Ophidia*, and *Chelonia*, while in the *Amphibia* we find the *Urodela*, the *Anura*, the *Peromela*, and the *Labyrinthodonta*.

Such a work should fully review up to date the entire history and literature of the subject; give the general characters of the Class *Reptilia;* their taxonomy or classification; their morphology or anatomy; the known extinct forms of Reptiles and Amphibians (palæontology); and the distribution and biology of the existing orders.

It is possible that the U. S. National Museum may publish before long a valuable work upon our United States reptiles, as I am aware that shortly before his lamented death, Professor E. D. Cope had completed a work of the kind.

As Dr. Günther of the British Museum has remarked, "The name Lizard (Latin *lacerta*) originally referred only to the small European species of four-legged reptiles, but is now applied to a whole order *(Lacertilia)*, which is represented by extremely numerous species in all temperate and tropical parts of the globe. Lizards may be described as reptiles with a more or less elongated body terminating in a tail, and with the skin either folded into scales (as in snakes) or granular or tubercular; legs are generally present—usually four, rarely two in number—but sometimes they are reduced to rudiments or entirely hidden below the skin; the jaws are toothed, and the two mandibles firmly united in front by an osseous suture. Eyelids are generally present. The vent is a transverse slit, and not longitudinal, as in

Crocodilians. Other structural characteristics, especially of the skeleton, separate lizards from the other orders of reptiles." We have a large number of species and subspecies of lizards in this country—a list altogether too long to think of enumerating here. One of my first contributions to herpetology was published as long ago as 1881 by the U. S. National Museum, the paper giving a description of the skeleton of our legless lizard, popularly known as the " glass-snake " (*Ophisaurus*). This very interesting and perfectly harmless lizard is quite common in the woods of our Southern States. A good-sized one may attain a length of eighteen or twenty inches, being of a serpentine form, with no external legs. When struck smartly with a stick, the " glass-snake " usually fractures into a number of pieces, but all the segments are post-anal, and really only take place in the tail of the reptile. There is a popular notion that these pieces may come together again, and grow so that complete recovery results, and things were as before the injury, but this is only one of not a few zoölogical myths still entertained by the uninformed. The " Glow-worm " of Europe *(Anguis)* is a similar kind of lizard, possessing an equal brittleness of its caudal extremity.

Those Spined or Horned lizards *(Phrynosoma)* of the western part of our country, called *Horned toads* by so many people, are not toads at all, but are representatives of one of the most interesting genera of lizards we have in our fauna.

As I said when writing to *The American Naturalist* from New Orleans in 1883, about our American chameleon *(Anolis principalis)*, that under all circumstances lizards are interesting creatures, meet them where we may; as one evidence of this, how often do we find them chosen, and that, too, for many ages gone by, as objects to adorn pottery, vases, and china, or modeled in silver and gold to be worn as jewelry, or cast in the baser metals for other purposes, such as bronze ornaments. There is something very mysterious at times, in their very look, their dignified mien, their almost provoking silence; this is changed in us to a sense of curious interest that is quickened as the reptile assumes its livelier air, darts along the tree branch that it may be on, or shoots with the rapidity of an arrow up the trunk of some old tree. This singular interest amounts to positive fascination as we come to know the *Anolidæ*, and I assure you our little American chameleon is one of the most engaging of the group, at the same time being one of the commonest of all the lizards found throughout the lowlands of Louisiana; indeed, I have known instances of two or three children capturing as many as twenty-five or thirty in some old magnolia grove in the course of an hour or two, and we may well imagine the number that would escape from our juvenile collectors. It is certainly the exception, though, that any one ever disturbs or injures, either in city or forest, this inoffensive and harmless little creature; entitled as we are, however, to claim this for ourselves, it must be remembered, and it is a fact, not commonly known, that in the town and its immediate neighborhood the chameleon has an uncompromising enemy in the domestic cat. This animal, I have been informed upon undoubted authority, will, when the opportunity presents itself, pass anything, meat, birds, and even fish, if there is the slightest chance of securing one of these lizards, of which it seems to be so inordinately fond. The cat will stalk one, just as we all have seen them attack some unsuspecting sparrow. Should the lizard be on the trunk of a tree, and low down near the ground, and the cat miss it in her spring, she will frequently, in her disappointment, chase it up the tree, where of course the reptile wins in such an unequal race.

In the forest, *Anolis*, no doubt, has many another animal foe that makes it its prey. Our smaller hawks often seize and devour them, when they appear, and are exposed in the open.

In addition to this, the chameleon is subject to other accidents; its long tail is frequently broken off; this may grow out again as it does in *Ophisaurus*, though I have in my possession a specimen where this extremity healed over instead. Another specimen in my collection has, some time or other, apparently long anterior to capture, lost a foot; in this case a very pretty little stump has resulted, leaving a member of considerable use.

I have, perched up before me, one of these little fellows that was taken for my special benefit several days ago; the reader is presented with a very careful and accurately measured drawing that I have made of him. They sometimes attain a length to exceed this one, by two or three centimeters, rarely more. His entire form is covered with the most delicate and minute scales, which are found to be larger along the borders of the jaws and top of the head, where they are regularly arranged. The nostrils are seen within the rounded border of the snout above, and the bright, black little eyes peep out through longitudinal slits forming the eyelids, the latter being at the base of rather sunken

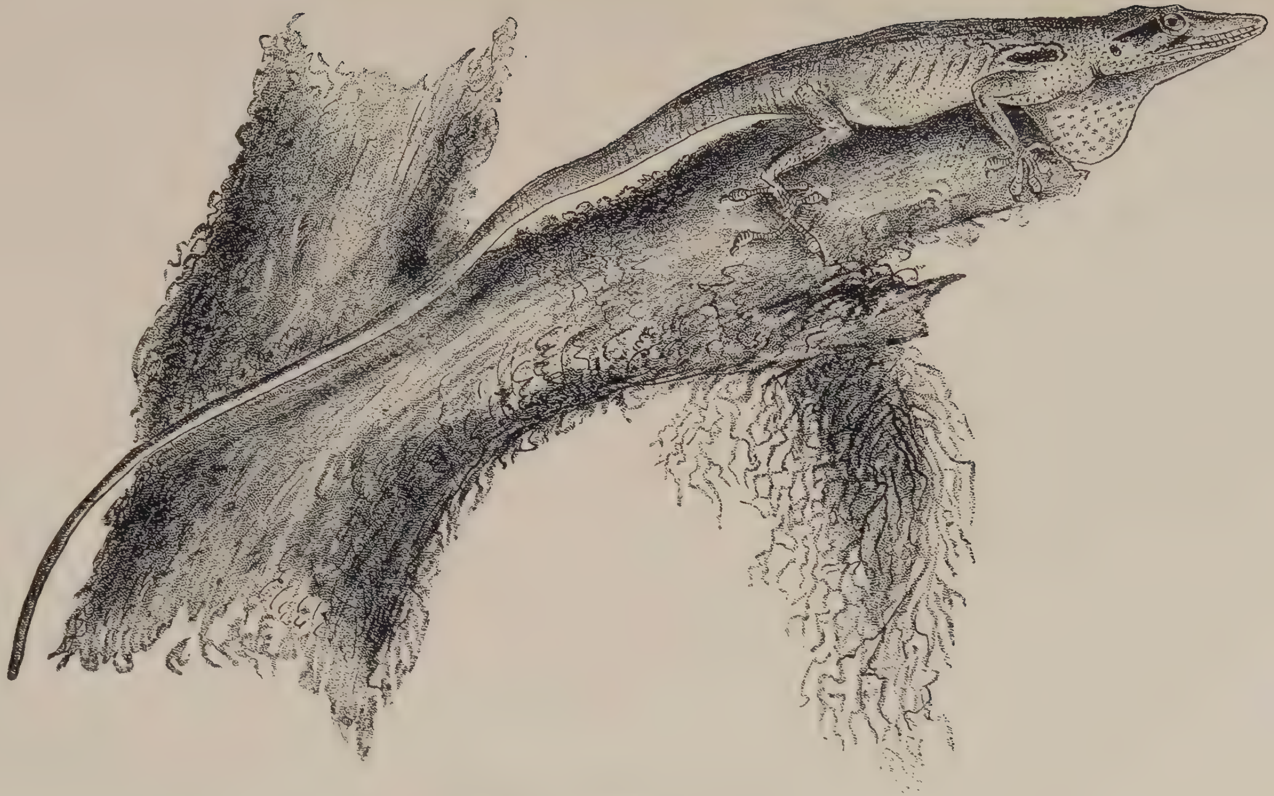

FIG. 27. *Anolis principalis.*

Life size. From nature, by the Author.

orbits. The oral gape is capacious, and the aperture leading to the internal ear is found a few millimeters to the rear of its commissure. In some specimens a jet black patch is found between the eye and ear, and another above the forearm on the side, surrounded by a whitish border; one or both of these markings may be absent, the anterior one being by far the most persistent. During deep inspiration eight ribs may be counted on either side of this lizard's body; these rarely show when the specimen is at rest and in good condition. See what peculiar feet he has, particularly the hinder pair, and I have taken unusual pains to represent these correctly, and to the best advantage. The fore feet are arranged quite symmetrically, but the toes on the rear pair can be spread out as shown in the cut, or drawn down, side by side, to form a very narrow and, we must own, much more sightly foot. Lying in the median plane, beneath the throat and reaching back as far as the sternal space, *Anolis* possesses a peculiar ornament; this consists in a fold of the common integument, controlled by an exceedingly interesting apparatus that gives it the power of protruding downward and slightly forward at will, carrying the fold with it, to fully the extent shown in the figure, or even more. Upon complete retraction this appendage is scarcely discernible. Its sudden appearance has a very striking effect, as the skin of which it is composed is of a bright red color, being decked over with the white scales, which are here larger than usually found elsewhere on the body, that stand apart by the stretching. Out of the large number of specimens that I have examined alive, this curious affair never appeared to be missing, though in some it was very much more prominent than in others, so we are forced not to attach to it any sexual distinction. The males are also crested along the dorsum, another feature which becomes more prominent when this reptile is excited. Under nearly all conditions the ventral parts of *Anolis*, except the continuity of the tail, are white, longitudinally striped with irregular dusky lines that are much more decided at the throat, and almost amount to a mottling on the belly and chest. A certain amount of mottling occurs high up and along the back. This lizard can assume, apparently at will, one of two colors, or an irregularly distributed combination of both of them; these colors are a bright pea-green, the alternative being a very handsome shade of brownish-bronze, very dark in some old specimens, very light in others.

The first time he comes under your observation he may be descending the trunk of some old cypress; you pause and cautiously approach him; he gradually slows down his advance to a deliberate walk, then stops, slowly raises the fore part of his body, turns his head to one side, and surveys you with a peculiarly knowing gaze, and perhaps even coldly winks once or twice, at long intervals. While this performance is going on his entire body becomes a dead brownish-bronze, ever and anon imperceptibly flushing a lighter tint. You make a step nearer, and he suddenly wheels and heads his course up the trunk, squatting very low as he does so; you come still a little nearer, and he advances up the tree in a spiral direction, until he is on the opposite side of the trunk and out of your sight. At this moment perhaps the thought seizes you to effect his capture, and you spring forward to head him off; but in his cunning he has outgeneraled you; he is nowhere to be seen on the sides of the rugged old trunk; so for a more general inspection you back away a few steps, when, to your surprise, far above your head you behold him stretched out along the first horizontal limb that extends from the main trunk. Who would believe it, though; who would take him for the same nimble little fellow that had just escaped your attack. He is now almost completely clothed in a suit of bright green, his crimson gular pouch protruding and retracting, reminding one of the opening and shutting of some tropical butterfly in the noon-day sun. At other times, when the surrounding circumstances seemed to demand it, he would have donned a coat made up of irregular patches of the two colors, with their various shades, at his command. This power of protective mimicry on the part of *Anolis*, for as an example of this we must certainly regard it, serves him best when he resorts, which he frequently does, to the bright green stalks of certain fresh-water reeds and plants that are found growing luxuriantly about the bayous and canals of his native haunts. It was in some such locality as this that, the other day, I observed one of the prettiest examples of this very same protective resemblance, that one would care to witness, almost equal to that famous butterfly that Wallace so admirably figures in his work upon the Malay Archipelago, now so familiar to all of us.

I had just scrambled over one of these so-called canals, that divided, by the aid of an old fence, an extensive marshy tract from a deserted field; this field was overgrown, in addition to various other kinds of undergrowth, with a tall, bright-green, ribbon-like grass. As I pushed my way into this, a shower of grasshoppers arose, making off in every direction; by accident, however, I discovered that two species did not resort to this mode of escape. One of these was of a shade of green that nearly matched the grass in question; the other, larger, was about the shade of the grass after it was dead and dried by the sun. They both had about the same form; the head was long and pointed in front, its apparent length increased by the insect bringing its antennæ together and sticking them out straight forward. Behind, the wrinkled wings trailed out to a sharp point, like the pointed extremities of the grass blades, and the heavy pair of limbs that spring from the metathorax were long and slender, so as to assist it in the deception. These insects, upon being alarmed, instead of taking to flight as the other varieties did, simply, and with marked deliberation, shuffled down *backward* to the pointed end of one of the leaves upon which it was resting at the time, and quietly hung there, where it demanded a pretty sharp pair of eyes to detect them, particularly if a breeze kept the grass in motion at the time.

Chameleons placed in alcohol for preservation change in all manners of ways; the larger share of the green usually disappears, the under parts often becoming so mottled as to mask the white entirely; it commonly brings out in strong relief the longitudinal stripes on the gular space; the mottling on the upper parts is likewise made far more evident than in the living reptile. The iris of *Anolis*, during life, is of a bright hazel, with a perfectly round pupil. When taken in the hand, they generally throw the jaws apart, and viciously seize any part of that member that may come within their reach. The bite of the larger specimens is quite a severe little nip, but I have never seen a case where their delicate teeth could inflict a wound of sufficient depth, so as to bring the blood. They will hang on for a long time, longer usually than our patience will hold out, and it generally results in our detaching them by the free hand. No doubt, as trifling as this bite may be, it often saves the life of our chameleon, as the unsuspicious, or children who pick them up out of curiosity's sake, upon being suddenly pinched in that way, are very apt to involuntarily wring the hand until the lizard looses its hold and promptly makes its escape in the grass or elsewhere.

During the morning hours, among the trees, the chameleons are rarely seen, but as the sun approaches the zenith, and the recesses of the forest begin to be thoroughly warmed, these little fellows may be observed descending the trunks of the trees to engage in their favorite hunting expeditions, about the gnarled roots that are exposed above the ground at their bases. Here they capture all manners of insects, which constitute their food, and it is during these feeding times that we have the opportunity to behold some of their quaintest movements. I was so fortunate, not long ago, as to catch one in the act, the instant after he had made a successful spring upon rather a large butterfly. The body of the insect was in his mouth, while the wings were violently flapping at the side of the lizard's face. The reptile would clinch his jaws together spasmodically two or three times, shutting his eyes with a very tight squeeze each time he did so. At last his prey was silent, when with a few energetic kicks he tore off the creature's wings, and disposed of his body *sans ceremonie.*

Anolis principalis no doubt renders, by its constant destruction of these insects which infest the trees of our Southern cities, a great service, and that, too, in a very modest and unassuming way. In this respect how much better they are than that miserable and noisy little foreigner, the so-called English sparrow, that we have taken so much pains to introduce and foster; a bird now found in every city of our Union, from Boston to New Orleans, in alarming numbers; I say alarming, because I know, full well, as every ornithologist in the land knows, that the day is sure to come when we shall have seen enough of his dappled brown coat, so constantly and impertinently intruded upon us, at the expense of our own avian favorites, and we shall learn to regard him, perhaps only when it is too late, as one of the agricultural pests of the United States.

The season approaches when Louisiana, recovering from the temporary shock caused by her mock winter, again puts forth the natural jewels of her animal and vegetable kingdoms, again presents us with fresh flowers and fresh fields, after so short a relapse. Birds once more stream northward, mammals throw off their semi-torpidity and resume their usual avocations. In the overflown bayous, rendered almost unendurable by an atmosphere charged with the aromatic odors of a budding Southern spring, we at this time, too, see the gaudy representatives of the reptilian world gradually make their several appearances. Frogs croak, hylas peep, and in some sunny nook the deadly moccasin

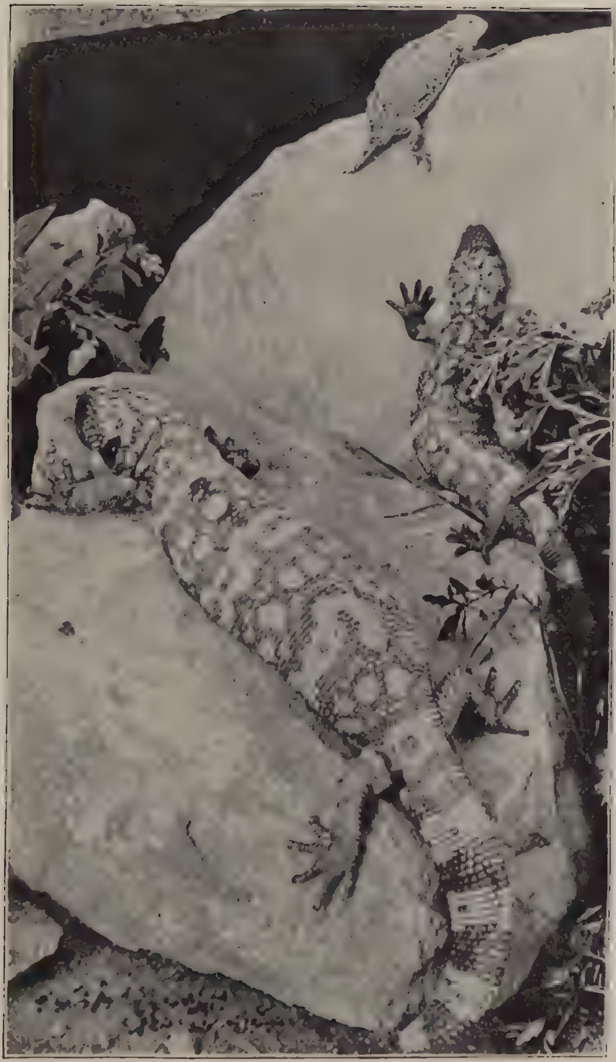

FIG. 28. GILA MONSTERS (*Heloderma suspectum*), AND DOUGLASS'S HORNED TOAD (*P. douglassii*).

From life, and considerably reduced.

warms his snuff-brown coils, alone, dreaded and shunned. All rejoice that this happy season once more opens, and the feeble grasp of the winter god is withdrawn. Where is *Anolis* now? we have not far to go, indeed, to find our bi-colored masquerader; see the emerald-clad scamp as he eyes you from the brawny limb of the pecan, under which you stand. But what is he up to! You quietly watch him, and his employment seems to be of such a nature that he soon completely ignores you, and proceeds with it at all risks, and at all costs. The mystery is soon solved, and we can readily appreciate this agitation, this bowing and strutting and all manners of odd motions, as if the very last drop of his quaint lacertilian blood was on fire—for coyishly, and with all due deference, reclines before his lordship his chosen mate, exerting her every chameleonic power to hide her blushes by vain endeavors to match the colored pattern of her couch, with all the bronzes and browns at her command. He can withstand her charms no longer, and for the moment, laying aside all dignity, and the object of his affections not unwillingly submitting, in the next instant finds herself in the passionate embraces of her lord, who, to make sure that he has actually won his coveted prize, winds about her lithe form, perhaps in some mystic love-knot, his entire caudal extremity, and blinds her eyes, first on one side and

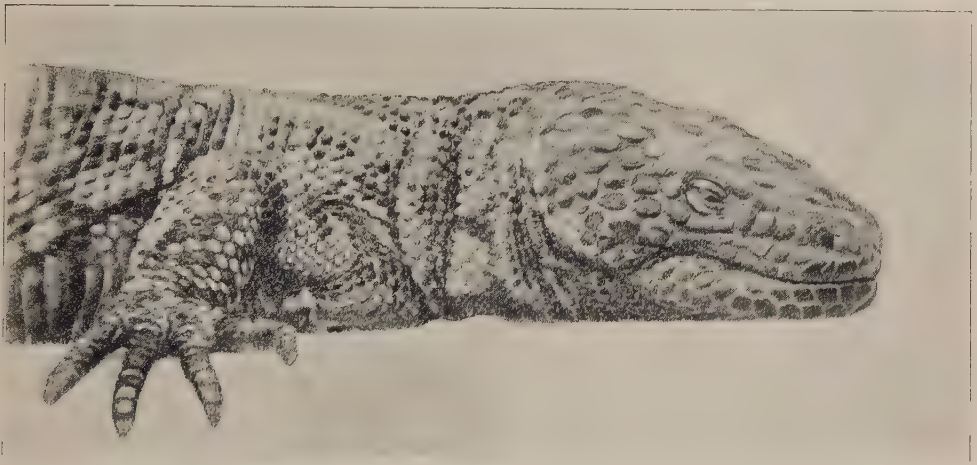

FIG. 29. RIGHT LATERAL VIEW OF THE HEAD OF HELODERMA SUSPECTUM.

Life size. From a photograph of the living specimen, by the Author.

then on the other, by the extension of the flaming ornament at his throat.

What a very different reptile we have in our big, sluggish Gila Monster *(Heloderma suspectum)* of the southwestern regions of the United States. These large lizards, still resting, in the eyes of many, under the suspicion of the charge of being venomous, I have had in captivity upon several occasions, and in former years have written and published a great deal about them. In Figs. 29-31, illustrating the present chapter, I reproduce some photographs of a large heloderma that I had for a long time alive, and these figures originally appeared in an article of mine in a New York medical journal in 1891, wherein the poisonous bite of the lizard was fully discussed up to date. There will also be found many references to the literature of the subject, and a comparison of views upon the poisonous or non-poisonous character of the saliva of the Gila Monster. In 1890 I published, with several plates, in the P. Z. S., of London, a one-hundred page memoir upon the anatomy of two species in the genus *Heloderma*—that is, *horridum* and *suspectum*, and eight years previous to that I printed in *The American Naturalist* an account of a severe bite I had received from one of the reptiles.

Professor E. D. Cope, when a guest at my house a number of years ago, told me that these figures—that is, the ones illustrating this chapter—" gave a better idea of the form of a heloderma than any of the many figures that had thus far been published, either here or in Europe." Between systematic persecution and the greed of zoölogical collectors, the Gila Monsters are now becoming very scarce in those regions where formerly they were abundant, and doubtless at the end of another half century, not one will be found in nature anywhere in the territory of what is now called Arizona.

While at Fort Wingate, in New Mexico, I also had a photographer make me a picture of two live helodermas I there had at the time. These are reproduced in Fig. 28; the large one is the same specimen shown in Figs. 29-31, while the smaller one I dissected from the London anatomical memoir. This figure gives an excellent idea of how these handsome lizards appear crawling over the rocks in a state of nature. Perched up on top of one of the stones will also be seen a small specimen of Douglass's Horned Toad *(Phrynosoma douglassii)*. Big helodermas may attain a length of twenty inches, they being orange and black in

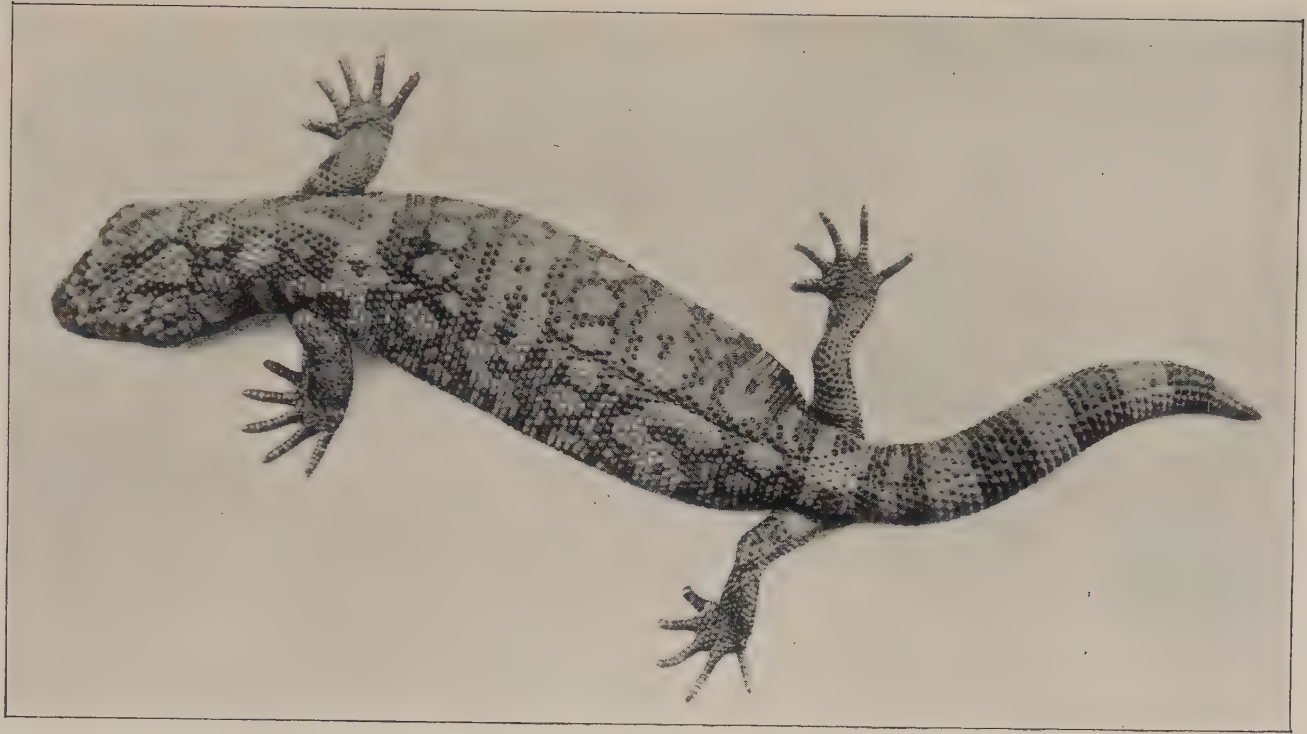

FIG. 30. DIRECT SUPERIOR VIEW OF HELODERMA SUSPECTUM.

From a photograph by the Author of the living specimen, and greatly reduced. Same specimen as in Figures 29 and 31.

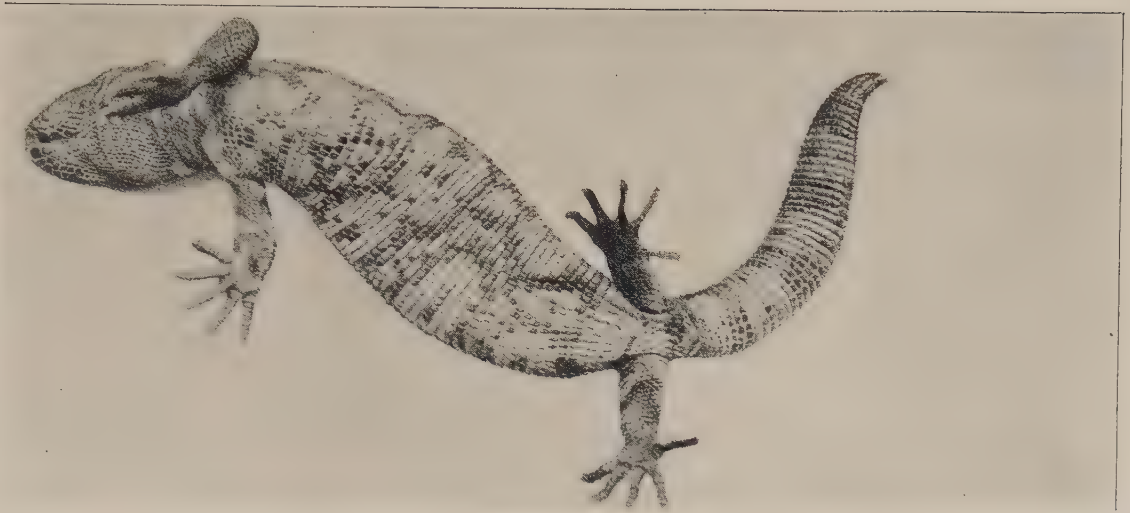

FIG. 31. VENTRAL ASPECT OF A HELODERMA.

From photograph of the living specimen by the Author, and greatly reduced; and the same as shown in Figure 30.

color, and covered with hard, rounded, tuberculated scales. They are very fond of birds' eggs, either raw or boiled, but prefer them raw. As they are by no means arboreal in habit, they can only secure such eggs of birds as build their nests upon the ground, or else very near it.

Besides the heloderms, I found while in New Mexico quite a number of other lizards, but they were all of the smaller species, perfectly harmless, and with more or less interesting habits. The genus *Sceloporus* was represented, and a little further on I shall say something about our eastern forms of these. Another pretty little fellow was found, though not very abundantly, which the Mexicans, or New Mexicans, called the Whipped-tailed Lizard, and which is more generally known as the Collared Lizard (*Crotaphytus collaris*). They are bright pea-green little fellows, ornamented with a black collar, and are very nimble in action. From a beautiful living specimen of one of these I secured a fine photograph, and this is reproduced in Fig. 32. *Crotaphytus* is a wood lizard, and is found in the heavy pine forests of New Mexico, but it also occurs in Texas, Arizona, Nevada, Utah, Arkansas, California, Indiana, and elsewhere.

The lizard called the "Six-lined Lizard" has a somewhat similar distribution, and I found specimens of these also in New Mexico. They are beautiful forms, gentle, shapely, graceful, and handsomely marked with narrow, jet-black, longitudinal lines upon a light-green body.

It was my practice to capture these lizards by shooting them with a cane-gun, loaded with No. 13 shot; it was the very rarest occurrence that they could be secured otherwise.

In making photographs of various species of our lizards, I found them to be a much easier class of subjects than many another kind of vertebrate, as, for example, any of the snakes, frogs, or toads, and very much easier than any of the land tortoises or the turtles; the latter constituting a very difficult class of subjects.

Last summer several successes were obtained in the case of the common little alligator lizard so plentiful in nearly all parts of the country. This is the *Sceloporus u. undulatus* of most herpetologists, but as the pretty, nimble little fellows have never reminded me in the least bit of an alligator, I have generally designated them as "wood lizards," from the fact that they are very fond of running up trees, and are rarely found out in the open country. These interesting little reptiles have frequently been kept in confinement by me for great lengths of time. A good-sized male lizard of this species may measure as much as seven or eight inches long, being earthy brown above, and a soiled white beneath. A patch of brilliant cobalt blue is found upon either side beneath, bounded with a deep black, while the back is transversely marked with wavy bars of a dark tint. Fig. 33 shows the male of one of this species, life size; I got him just as he jumped from my finger on to the pine limb upon which he is represented; so his attitude is perfectly natural.

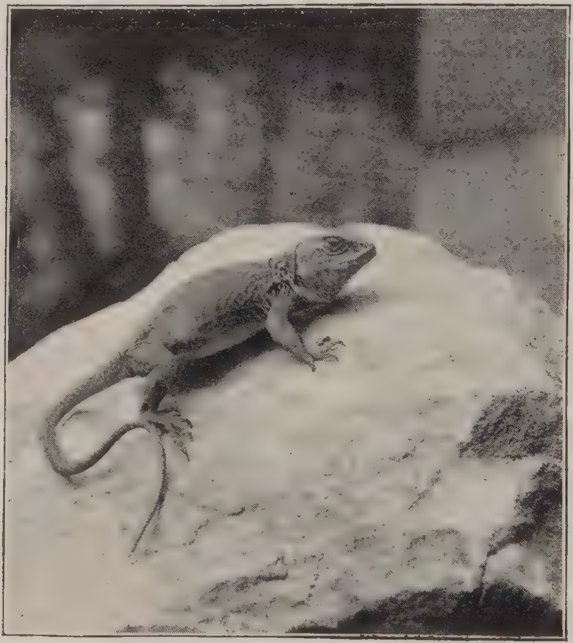

FIG. 32. THE COLLARED LIZARD (*Crotaphytus collaris*)
Photographed from life, and reduced about one-third.

In captivity this lizard will readily feed upon flies and many other varieties of soft insects. They will also breed; the female resembling the male much in appearance, although she is lighter tinted and shows scarcely any of the cobalt coloring beneath. I have had them to go, as a matter of experiment, for two or three months without eating or drinking anything at all, and then they did not show the effects of the prolonged fast very much. How-

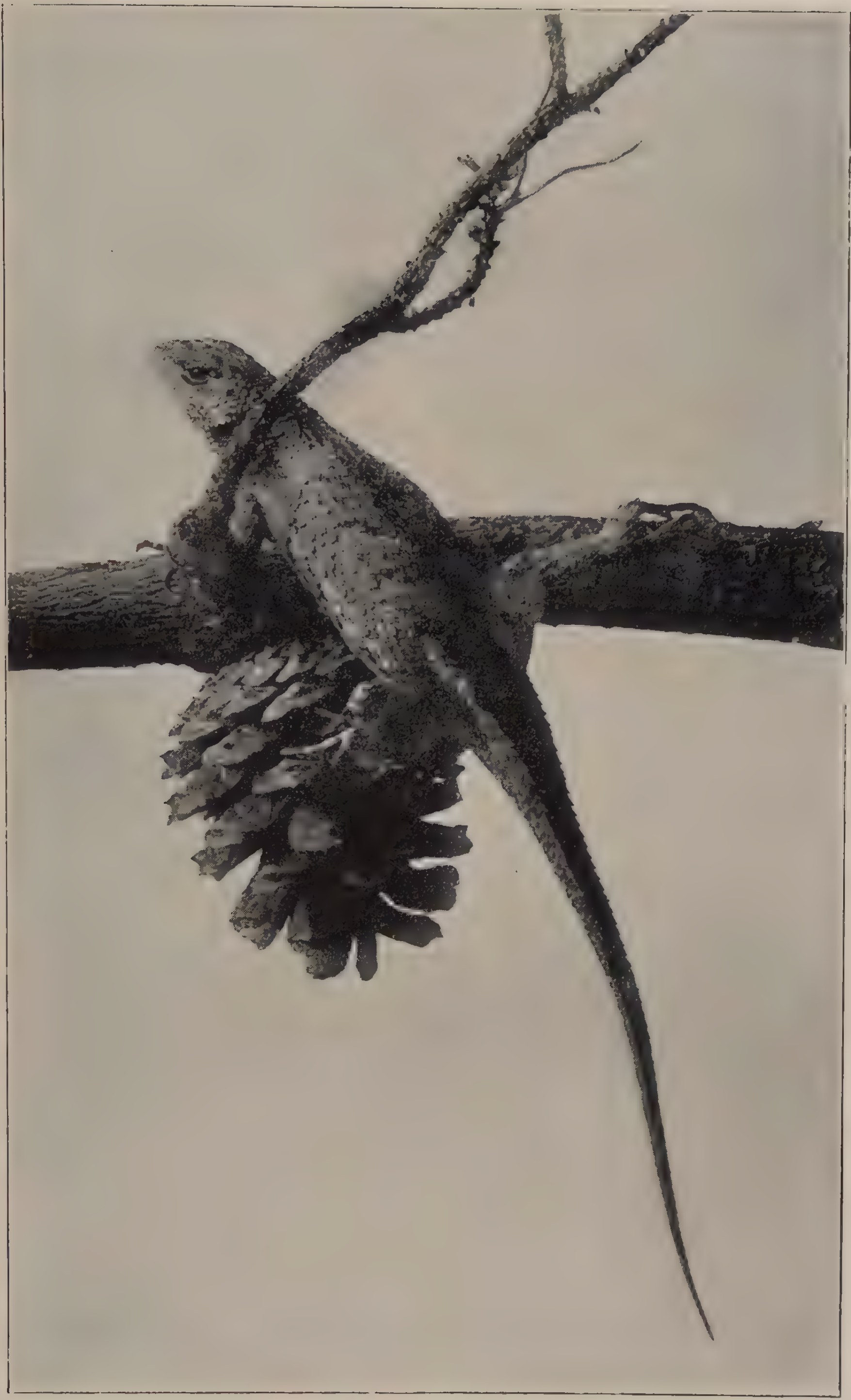

FIG. 33. *Sceloporus undulatus.* ♂

Life size. From a photograph taken by the Author.

ever, after such an ordeal they always appear to be very glad to get a chance at some big fat flies. This reptile is perfectly harmless, and its bite amounts, at the best, to but a good little nip, its delicate teeth being unable even to break the skin. So far as my observations go, they usually lay from six to eight pretty white eggs of an ellipsoidal form, placing them in a line in some dry crevice, either in an old dried tree trunk, or in a suitable place in a rock. Young ones are extremely cunning little fellows, and active from the very first.

Should one of these lizards have its tail fractured off by accident, the appendage will grow out again, the bones being replaced by firm cartilaginous nodules. Sometimes it happens that two tails take the place of the one lost, as I have seen on several specimens of the American chameleon *(Anolis principalis)*, many of which species, as I have said above, were captured and studied by me fourteen or fifteen years ago at New Orleans, La.

Many of the most remarkable lizards in the world are found in the tropics, especially in the tropical parts of the East and West Indies, Africa and South America. To gain a full knowledge of the class *Lacertilia*, the student should take occasion to study these as far as opportunity will admit, and in doing so especial attention should be directed to such species as the Monitor of the Nile (*Monitor niloticus*); to the peculiar limbless lizards of Australia *(Lialidæ*, etc.); to the Skinks *(Scincus)*; to the various species of Iguanas *(Iguanidæ)*; to the various so-called Dragons *(Draco)*; to the truly extraordinary frilled lizard of Queensland *(Chlamydosaurus)*; to the Chamæleons of Africa and Madagascar *(Chamæleon*, etc.); to the peculiar Geckos that are found in many parts of the world, and have the most remarkable habits.

CHAPTER IX.

PROTECTIVE COLORATION IN SNAKES, WITH OTHER NOTES ABOUT THEM.

(*Ophidia.*)

SPEAKING of protective mimicry and protective coloration in snakes, one of the prettiest examples of it known to me among those reptiles in eastern North America is often seen in our common little Summer snake, described by naturalists as *Cyclophis vernalis.* One warm day last spring, as I was passing through a thin, broken piece of maple woods, with an undergrowth of brambles and bushes of various kinds, my attention was drawn to a mass of smilax vine, the stems of which were as green as green could be, and its beautiful leaves had attained only about half their full size and growth. Something moved in a peculiar gliding manner adown its thorn-bedecked branches, that was of a shade of green corresponding exactly with that of the vine itself, and in an instant I realized that it was a large specimen of the Summer snake. The reptile was over 20 inches long, and as slender as the lash to a boy's whip. It was of a very pale yellowish green upon its nether aspect, while the entire dorsum was of an emerald hue. Small and delicate in structure, its oval head was but a trifle larger than the continuation of the neck, and knowing the creature to be as gentle and as harmless as any living thing in the world, I carefully drew it away from the vine with my hand, and coiled it up in a paper cone, which I duly placed in my pocket. Then with my knife I cut clear the very part of the vine in which I had first discovered the *Cyclophis*, and with this I came direct home, before the leaves had any opportunity to wilt. Within an hour a good photograph of this pretty subject was obtained, and the reproduction of this is shown in Fig. 34 of the present chapter. These gentle little snakes are preyed upon by other snakes, by hawks and other birds, and maybe by some mammals. So their green color and extremely slender form greatly protects them against their enemies, and renders them far less likely to be seen by them. Some contend, and very erroneously I think, that this particular coloration in the snake is to make it less likely to be observed by the insects upon which it lives, and thus insures the

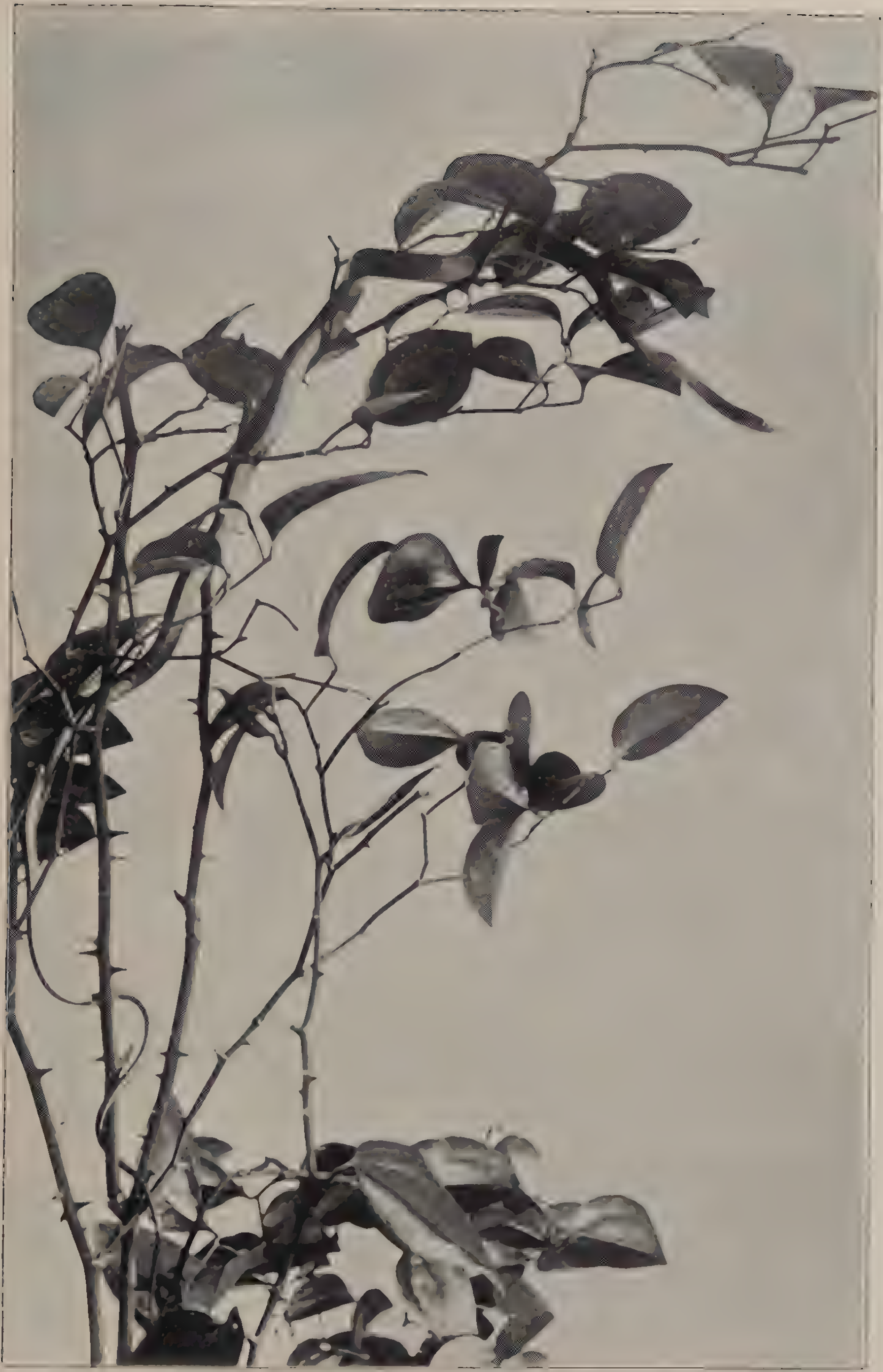

Fig. 34. Summer Snake (*Cyclophis vernalis*) in Smilax Vine.

One-third natural size. Example of protective coloration. Photograph by the Author from life.

snake of a more certain chance of getting its food and sustaining life.

There is one other representative of this genus of snakes with us, closely resembling *C. vernalis* in form and size, but is of a bright bluish-green color, instead of being green; and, be it said here, it is truly remarkable how well even this tint protects the creature in many situations in its natural haunts. I saw this especially among the bayous of lower Louisiana, where this snake is frequently to be observed among the stalks of a species of pond lily that are likewise of a bluish-green tint, and for one of which it can easily be mistaken. *Cyclophis æstiva* is the name science has bestowed upon this species, and its delicate scales are longitudinally keeled or carinated, instead of being smooth, as in *C. vernalis.* In this connection it will be remembered by many how well the coloration of the various species of Rattlesnakes and Moccasins protects them by closely matching the compositions of their particular environments. Among the bogs and fens found in certain localities about Washington, D. C., I found, during May, 1896, many of the young of the common Water Snake (*Natrix sipedon*), and these little dusky colored fellows often so closely resembled in shade the blackish mud over which they cautiously moved as to nearly escape my keenest observation. In Fig. 35 will be seen the reproduction of a photograph I made last spring of the young of this very species. He was coiled up upon the dark earth, where grew several species of ferns and other swamp plants; and where lay dead twigs and leaves, dark and stained by partial or complete decomposition. His form was hardly to be noticed amid such growths and debris, as it could easily be mistaken for some twisted and water-soaked root coiled up there. Indeed, I did not notice him until he began to take himself off.

Beddard speaks of the protection in snakes often being due to the multiplicity of surrounding objects, and says when "a conjurer intends to surprise his audience by the production of an object from some unsuspected quarter, he places it beforehand, with no attempt at concealment, upon the table, which is generally covered with various mysterious objects not meant in the least for use. It is concealed until the right moment among a multitude of objects, some more, some less like it. Every one knows from experience how difficult it is to find an object which has fallen upon a carpet with a complicated pattern. We find exactly the same principle in nature."

Professor Drummond gives a good instance of this in his work upon tropical Africa. "One of the most beautiful and ornate of all the tropical reptiles is the puff-adder. This animal, the bite of which is certain death, is from three to five feet long and disproportionately thick, being in some parts almost as thick as the lower part of the thigh. The whole body is ornamented with strange devices in green, yellow, and black; and lying in a museum its glittering coils certainly form a most striking object. But in nature the puff-adder has a very different background. It is essentially a forest animal, its true habitat being among the fallen leaves in the deep shade of the trees by the banks of streams. Now, in such a position, at the distance of a foot or two, its appearance so exactly resembles the forest bed as to be almost indistinguishable from it."

Our brilliantly colored little Coral snake of the Southern States (*Elaps*) is also very conspicuous with its shiny transverse bands of alternate red and black; but this serves a very different purpose, and is to be treated under the subject of "Warning Coloration," a matter our space will not admit of touching upon in this chapter.

While engaged last spring (1896) in making photographic pictures of various kinds of animals, snakes among the others were by no means overlooked or neglected. In using the word animal here I do so in its zoölogical sense, for when a naturalist speaks of an animal, he may or he may not mean a mammal, which is the ordinary application of the term, but any organized form from those found in the lowest orders to the highest, including even man. As thus applied, not only are mammals spoken of as animals, but such types as birds, frogs, or fish, and the like.

My first attempts at photographing snakes were made some five or six years ago, when several fairly good pictures of the Blowing viper *(Heterodon)* were made; but these were by no means so good as those obtained last May, at which time various other species were taken.

During the year just mentioned above, there occurred about the city of Washington, in the District of Columbia, an unusual number of the snake known as the Blotched King snake; more, indeed, than any of this species that had ever been noticed in this locality in former years. It is a harmless snake, that may attain the length of some thirty inches, or rather more, and is characterized by having a darkish body, lighter beneath, and

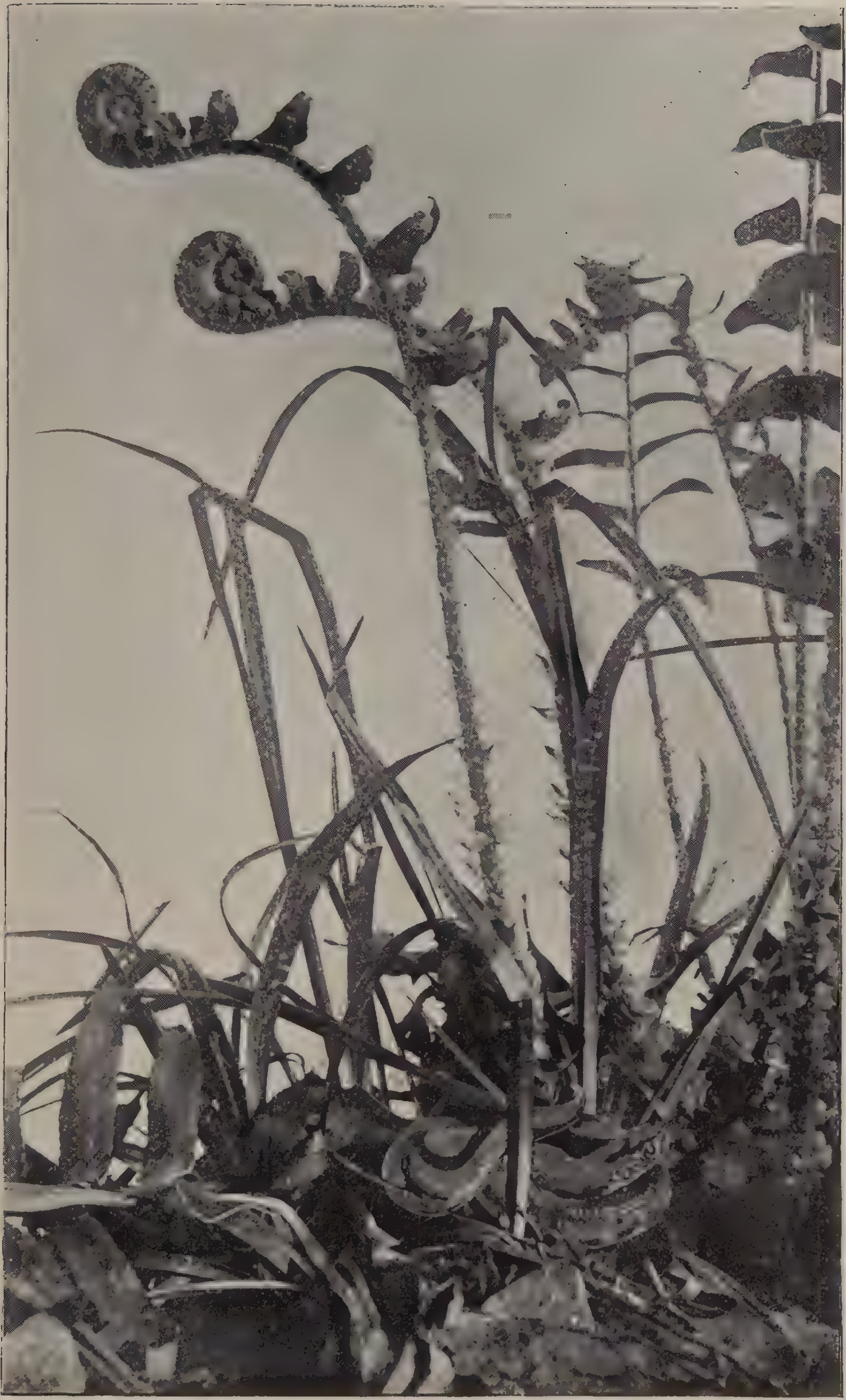

Fig. 35. Young of Water Snake (*Natrix sipedon*).

From a photograph taken by the Author, and intended to show protective coloration.

blotched over with numerous irregular spots or patches of a bay or pale chestnut color. Formerly, in technical parlance, this species was known as *Ophibolus rhombomaculatus*, but the accepted general name is, at this writing, *Lampropeltis.* Its specific name was given it because the spots or blotches upon its body most frequently were rhomboidal in outline, or very nearly so. The juvenile collectors in my vicinity often brought me in, during the time mentioned, numerous examples of this reptile; and one fine morning, there being an unusually handsome example presented, it was chosen for a photograph. A small forked branch of a pine tree was placed in position in the proper light in my studio, and his snakeship allowed to coil himself about one of the limbs. Being a little sluggish in movement at first, it did this in a very deliberate manner, giving me abundant time afterward to focus upon the subject. After my shutter to the camera had been closed and set, and the slide to the plate-holder withdrawn, something called me suddenly away, and, upon returning in a few moments, the snake had partially lowered itself down the limb, and was prepared to make its escape.

I cautiously reached for the pneumatic bulb of the shutter, and succeeded in getting a hold of it with my right hand, while the movement was sufficient to cause an arrest in the descent of my snake. The fore part of its body, including the head, was outstretched freely into space, and presented a beautiful double curve.

For an instant I observed this part of its length with the closest possible scrutiny, and it did not appear to move in the least; but my diaphragm was of very small aperture, and I hardly dared to expose the plate. Nevertheless, we must take many risks in such matters, and expose I did, with a very firm and steady squeeze. Then in a few seconds the shutter was slowly allowed to close, and the attempt completed. Upon developing my plate it proved a success, and the reproduction of my picture is shown in Figure 36 of the present chapter.

We have in this country upward of two dozen species and subspecies of King snakes, the common one being *L. g. getulus*—a very handsome reptile, though one most mercilessly destroyed whenever met with in its haunts by the ignorant and thoughtless.

Besides the long list of harmless and useful snakes in this country, belonging to many genera, we have three kinds of venomous ones. These are the Rattlesnakes *(Crotalus, caudisona)*, the true Moccasins *(Ancistrodon)*, and the Harlequin snakes (*Elaps*).

Taken as a whole, the order *Ophidia* of the Class *Reptilia* has been created to contain all the snakes, closely allied as they are to Lizards *(Lacertilia)*, there being not a few forms that connect the two groups. Günther tersely characterizes the *Ophidia* in the following terms: Snakes are vertebrates with "an exceedingly elongate body, cylindrical or subcylindrical, and terminating in a tapering tail. The integuments are folded into flat imbricate scales, which are rarely tubercular or granular. The spinal column consists of a very great number of vertebræ, with which the numerous ribs are movably articulated. Limbs are entirely absent, or only rudiments of the posterior occur more or less hidden below the skin; there is no sternum. The bones of the palate and jaws are movable; the mandibles are united in front by an elastic ligament, and are very distensible. Generally both jaws and the palate are toothed, the teeth being thin and needle-like. There are no eyelids, no ear-opening. The vent is a transverse slit." There are probably about 2,000 snakes known, and many more yet remain to be described, the tropics being the region in which their occurrence is most abundant. There, too, do we find the most venomous as well as the largest forms of them.

There are species of snakes that live in burrows, rarely coming out, and there are snakes that habitually live upon the ground, while others are typical tree-snakes. Besides these there are fresh-water and sea snakes; the latter (with the exception of one genus) never quitting that element.

The majority of the ophidia lay eggs; some, on the other hand, are viviparous. In the matter of food they vary greatly: the non-venomous burrowing-snakes subsist principally upon insects and other invertebrates; the ground-snakes, which may be poisonous or the reverse, live largely upon various vertebrata; some of the tree-snakes are also venomous, and they prey upon arboreal animals and the eggs of birds; finally, nearly all the fresh-water snakes are innocuous, and they live upon aquatic animals, which is likewise the case of the sea-snakes, but these latter are all highly poisonous. In habit, we meet with both diurnal and noc-

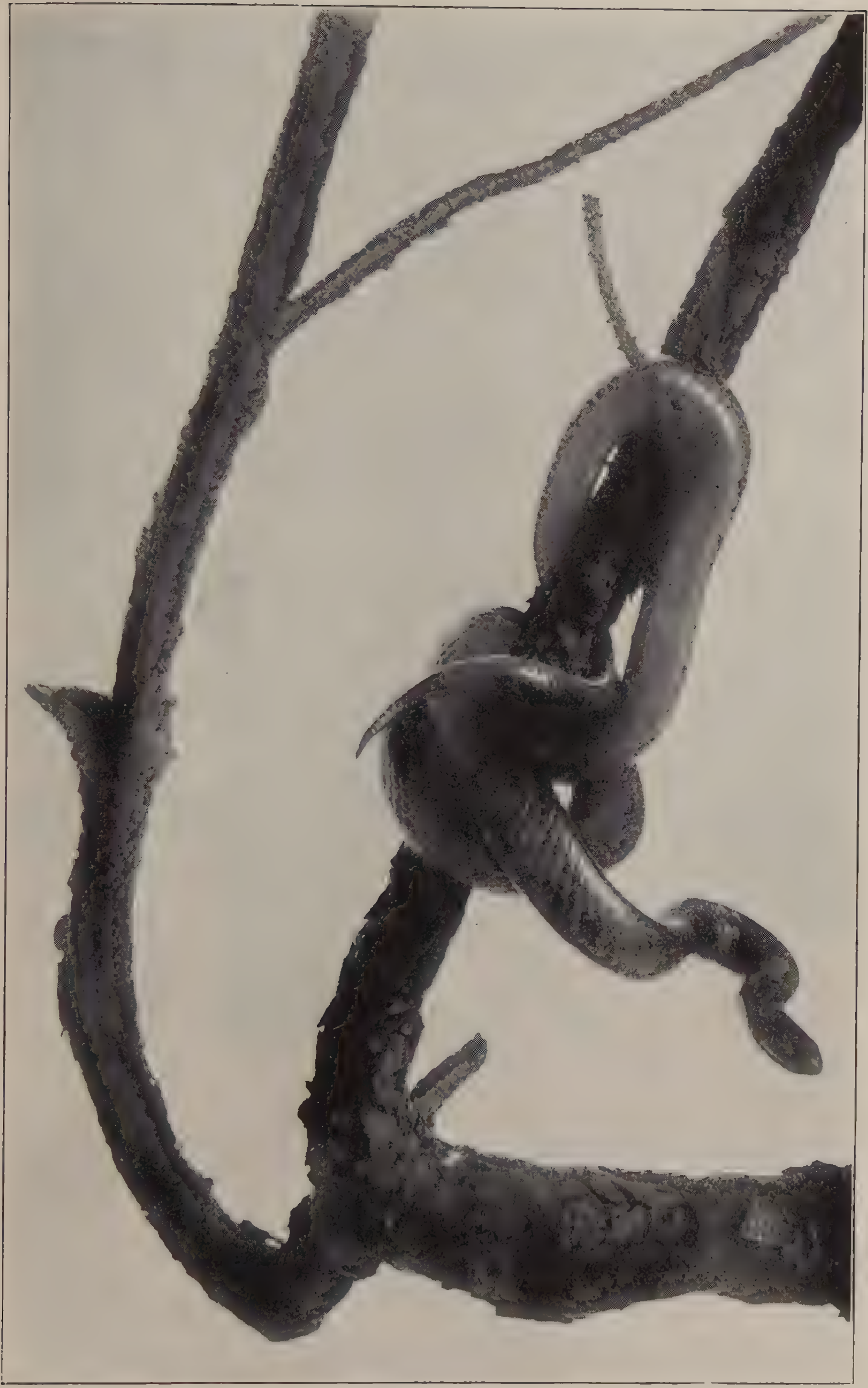

Fig. 36. The Blotched King Snake (*Lampropeltis rhombomaculatus*).

From a photograph from life, taken by the Author. About one-third natural size.

turnal varieties, while as a rule they are stationary by preference, remaining long in any particular locality, or as long as the food in it is plenty. In them the action of the ribs takes the place of limbs, and constitute their organs of locomotion, the various movements of snakes being a very interesting study. These movements consist in their action upon the ground, in the water, in trees; in their modes of attack; in their fighting each other, and in copulation, ovulation, and the struggles of death. As with other vertebrates, snakes are classified in accordance with their anatomical structure and habits. Many of the structural characters found in snakes are worthy of the closest study. For example, the difference between the dental armature of a truly venomous snake and an innocuous one is very characteristic. The pattern of the tooth-marks, when the teeth of either kind are driven into the flesh, are distinctly different. In the case of a poisonous snake, we note the two roughly parallel rows of central teeth, while in front, upon either side of these, the row of two or three punctures made by the poison fangs. These last two rows of wounds are parallel to each other. Now, the two rows of central tooth-punctures in a harmless snake are similar to those of a venomous one, but the difference occurs in the lateral or outside rows. They are long and curved, the curves corresponding to those of the upper jaw of the reptile, the entire margin of which is usually armed for its whole length by a long, single row of minute teeth upon either side, but the rows not meeting in front. Then, again, there is that interesting structure, the "rattle" of the rattlesnake, and upon this an authority at hand has said: "The bone by which the root of the rattle is supported consists of the last caudal vertebræ, from three to eight in number, which are enlarged, dilated, compressed, and coalesced. This bone is covered with thick and vascular *cutis*, transversely divided by two constrictions into three portions, of which the proximal is larger than the median, and the median much larger than the distal. This cuticular portion constitutes the matrix of a horny epidermoid covering which closely fits the shape of the underlying soft part, and which is the first commencement of the rattle, as it appears in very young rattlesnakes before they have shed their skin for the first time. When the period of a renewal of the skin approaches, a new covering of the extremity of the tail is formed below the old one, but the latter, instead of being cast off with the remainder of the epidermis, is retained by the posterior swelling of the end of the tail, forming now the first loose joint of the rattle. This process is repeated on succeeding exuviations—the new joints being always larger than the old ones, as long as the snake grows. Perfect rattles, therefore, taper toward the point, but generally the oldest (terminal) joints wear away in time and are lost. As rattlesnakes shed their skins more than once every year, the number of joints of the rattle does not indicate the age of the animal, but the number of exuviations which it has undergone."

Another interesting structure is found in our common Bull or Pine snake *(Pityophis sayi bellona)*. Years ago, when I was assisting in the work of the Reptile Department of the Smithsonian Institution, Dr. Charles A. White, the distinguished paleontologist, came to me one day and asked if I had ever examined the peculiar structure of the epiglottis in the Bull snake, and how that by forcibly blowing and the consequent violent vibration of the epiglottis, the snake could produce the threatening noise that it did. Replying in the negative, I further remarked that the fact had not ever been published that I was aware. Shortly after, Dr. White gave an excellent description of the mouth parts of one of those snakes, and it was published in *The American Naturalist* for January, 1884 (p. 19). My own figures illustrated the paper, and these are here reproduced in Figs. 37 and 38, and will show how the vertical plate of the movable epiglottis *b*, standing directly in the middle line and in front of the glottis *c*, would vibrate whenever the breath was driven out of the aperture of the latter.

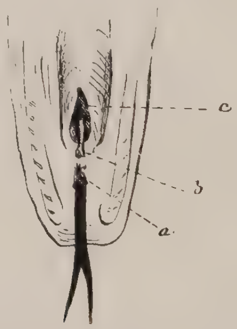

FIG. 37. FLOOR OF THE MOUTH OF A BULL SNAKE (*P. s. bellona*).
Seen directly from above (reduced). *a*, Sheath of Tongue; *b*, Epiglottis; *c*, Glottis.

Several years after, Professor Cope, of Philadelphia, found this structure developed in other genera of American snakes, and he published a very important and interesting article upon the subject (*Amer. Nat.*, Feb., 1891, p. 156). Bull snakes are entirely harmless, and at the same time very handsome and most engaging reptiles to study. It was in *The American Naturalist*, too, that I published the first recorded instance of our common Black snake attacking man. It was a personal instance, and was printed in the April number of that journal for 1891.

In a former paragraph of this chapter it was stated that in accordance with the opinion of Dr. Günther, of the British Museum, that the ribs of snakes were their principal organs of locomotion. I do not altogether concur in this opinion, but rather incline to the view of Packard as expressed in his *Zoology* (pp. 496, 497). This eminent American naturalist there says: "The peculiar gliding motion of snakes is effected by the movements of the large ventral scales, which are successively advanced, the hinder edges of the scales resting on the ground and forming fulcra; resting on these, the body is then drawn or pushed rapidly forward." It seems to be now a well-settled fact that snakes never move over the ground by alternate bends of the body's length, the movement being in a vertical plane. On the contrary, they glide over the surface by a wriggling motion in the horizontal plane. Then, again, in striking at their enemy or prey, they never entirely quit the ground, or lose contact with it. The part that does that is only about the anterior fourth of the body,

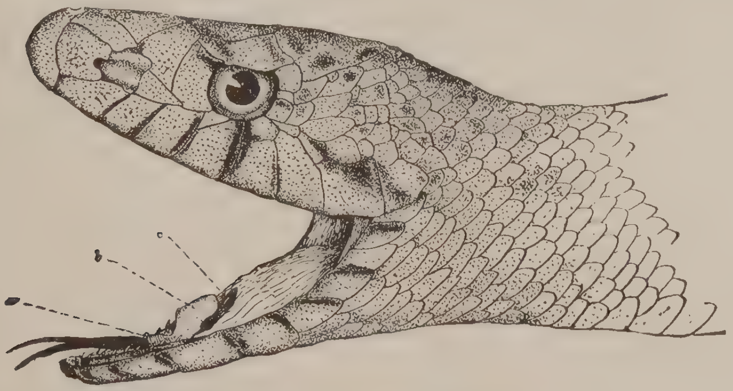

Fig. 38. Left Lateral View of the Head of a Bull Snake.

Natural size. Lettering the same. Drawn as in Fig. 37 by the Author.

which is suddenly straightened out and again as rapidly withdrawn when the reptile strikes. Speaking of the snake's *body,* the question has often been asked me, What part of the creature is body and what part is *tail?* The answer to this is that the body and tail of a snake, although they seem to imperceptibly merge into each other, are, in reality, quite distinct, for the dividing line is at the animal's anus, beyond which, on the ventral side, the arrangement of the scales is usually different.

Several times every twelve months most snakes shed their entire skin, which latter normally slips off in one unbroken piece. The surfaces of the eyes are included in this " shed," and it is during this operation that snakes are popularly pronounced to be blind. The brilliantly colored varieties are redoubled in their beauty as the old skin comes away. An adult King snake is truly a lovely object to behold just after the moult, with his new, shining coat of gorgeous black and yellow coloring.

The accounts of young snakes of certain species running down the throats of their mothers when alarmed, or to escape danger of any kind, are now well authenticated, and such statements can doubtless be taken as true.

In closing this chapter I would say that of all animals that now live upon the globe, or ever have lived upon the globe, few there are that can boast of having cut a more remarkable figure in written history than can that group of reptiles which for ages have been known as snakes.

From time immemorial these creatures have been talked about and sung about by nearly all the races of people, both living and departed; their written history, popular and scientific, would today make of itself a very large library of many hundreds of volumes. Snakes have been shunned and have been widely persecuted; have been worshiped, dreaded, despised, and glorified. They have stood as emblems of wisdom, of evil, and of deceit. They have played their part in witchcraft, in medicine, and have been eaten as food. Indeed it would be impossible in our limited space here to one-half enumerate the many-faced phases their history has won, especially in view of the fact that better pens than mine have already done much of this for us. However, science will be well served if young and observing naturalists in this country will intelligently make records of the habits of our snakes, or scientific accounts of their anatomy, geographical distribution, and all else pertaining to their biology. We still need a great deal along these very lines, and the study is as engaging a one as any naturalist, young or old, would care to enter upon.

CHAPTER X.

TURTLES AND TORTOISES.

(*Chelonia*.)

As has been stated in a previous chapter, naturalists place all the existing forms of turtles and tortoises in an order, *Chelonia*, it constituting one of the groups of the Class *Reptilia*. There are upward of 250 species of them known, the majority of which are fresh-water types, being most numerous in tropical and sub-tropical regions, where the country is well watered by ponds, rivers, lakes, and marshes. Taken as an assemblage of vertebrated animals, the existing forms are a well-circumscribed group, and are not represented by any true aberrant species. It is with the *Batrachia* only that they can claim any affinity, as is shown by their structure. From all other existing reptiles they are clearly distinguished by the hard osseous shell that incases their bodies, divided as it is into an upper or domed portion called the *carapace*, and a ventral or flat part, termed the *plastron*. Further on I shall describe these structures a little more in detail.

Chelonians have the skin of the head, neck, legs, and tail, either covered with scales or tubercles, or else soft and smooth, as in our soft-shelled turtles. Sometimes an osseous nucleus occurs in the scales or tubercles, such as we find in *Heloderma* or on the back of our crocodiles.

Peculiarities of the greatest interest to the anatomist mark the skeleton and other structures of these animals. A short tail is always possessed by them, and this in some species may be more or less elongate. Without exception, the entire order is toothless, the margins of the jaws being armed with a horny sheath, with cultrate edges, corresponding to the same structure as we find it in hard-beaked birds, as, for example, a parrot.

In the United States we have the *Chelonia* represented by upward of fifty species, and many subspecies. There are among these the more lowly organized, paddle-footed, great marine turtles, such as the Loggerhead, the Green Turtle, and the Hawk's-bill. Many of these live to be of great age, and grow to immense proportions, in some cases coming to weigh as much as 1,200 pounds, at the same time attaining a length of eight or nine feet *(Spargis coriacea)*. In our fresh-water turtles the toes of the limbs are distinct, clawed, and the feet are usually webbed, if not always so.

In speaking of this group in his *Zoology*, Professor Packard remarks: "The terrapins belong to the genus *Pseudemys;* the pretty painted turtle (*Chrysemys picta* Agassiz) is common in the Eastern States, while the *Nanemys guttatus* (Agassiz), or spotted tortoise, is black, spotted with orange. In the land tortoises the feet are short and stumpy. The *Testudo indica* of India is three feet in length. The great land tortoises of the Galapagos Islands, the Mascarine Islands (Mauritius and Rodriguez), and also of the Aldabra Islands, lying northwest of Madagascar, are in some cases colossal in size, the shells being nearly two metres (six feet) in length. The fierce Mascarine species were contemporaries of the Dodo and Solitaire, and are now extinct. The bones of extinct similar species have been found in Malta and in one of the West Indian islands. The land tortoises are long-lived and often reach a great age. Certain tortoises of the Tertiary Period, as the *Colossochelys* of the Himalayas, had a shell twelve feet long and six feet high. The turtles extend back in geological time to the Jurassic, a species of *Compsemys* being characteristic of the Upper Jurassic beds of the Rocky Mountains. (Marsh.)

"The eggs of turtles, as those of birds, are of large size; they are buried in June in the sand, and left to be hatched by the warmth of the sun. It is probable that turtles do not lay eggs until eleven to thirteen years of age. The development of turtles is much as in the chick. By the time the heart becomes three-chambered, the vertebræ develop as far as the root of the tail, and the eyes are completely inclosed in their orbits. The shield begins to develop as lateral folds along the sides of the body, the narrow ribs extending to the edge of the shield. In the lower forms of turtles *(Chelonioidæ)*, the paddle-like feet are formed by the bones of the toe becoming very long, while the web is hardened by the development of densely packed scales, so that the foot is nearly as rigid as the blade of an oar."

During the summer of 1885 I paid not a little attention to the study of a few species of our common tortoises and turtles, and read something about them in the books. The ordinary land tortoise, or box-tortoise, is very abundant where I live, near Washington, D. C., and many of them, of all ages and sizes, fell into my hands that year. Several of these I kept alive and observed their habits; some of them I photographed in different attitudes, and one of these (one about two-thirds grown) is presented as an illustration here. Naturalists call this species *Cistudo carolina*, being one of the terrestrial representatives of the group. It is known as a tortoise, a word probably derived from the old French term *tortis*, twisted, referring to the apparent twist in its fore-limbs. We usually call the aquatic forms turtles, and some of them terrapins. The beautiful orange and black and brown markings of our box-tortoise do not show in his picture, because they will not take in an ordinary photograph. It requires a great deal of patience to secure these photographs of living tortoises, because the animal is frequently very unruly and hard to manage. Some twenty-five or thirty years ago I collected an unusually fine specimen of this box-tortoise, that had a shell that was most beautifully marked, and particularly perfect in form and other respects. This shell I preserved and kept, and it is before me at the present writing. Its superior, or dome-part, as stated above, we call the carapace, while the breast-plate below, that has the transverse hinge in it, is known as the plastron. These dorsal and ventral shields that protect the entire body of the box-tortoise are joined at the sides by the lateral arches. Now the carapace and plastron are overlaid by their hardened and brittle plates. These belong to the skin-system, and so have been termed epidermoid scutes. As has already been said, they are variegated in color and in pattern in *Cistudo*, and have a definite arrangement, as in other chelonians. Viewing our specimen from above, it will be seen that there is a longitudinal row of these plates, with a lateral row upon either side, and, finally, there is a row of similar scutes all the way round the border. Upon the plastron there is simply a double longitudinal row of much bigger plates. These epidermoid plates do not match, either in form or arrangement, the bones of the true carapace and plastron. To show this well, I have made drawings that I adapted for the present purpose from figures given us by Dr. Günther, formerly of the British Museum. They are shown below in Figures 40 and 41, and represent the carapace (Fig. 40) and the plastron (Fig. 41) of *Testudo pardalis*. The first-named is seen from above, and the latter is viewed upon its ventral surface. The margins of the integumental scutes are indicated by entire lines, while the sutures or borders of the bones of the osseous carapace are shown in dotted lines. Biologists for many

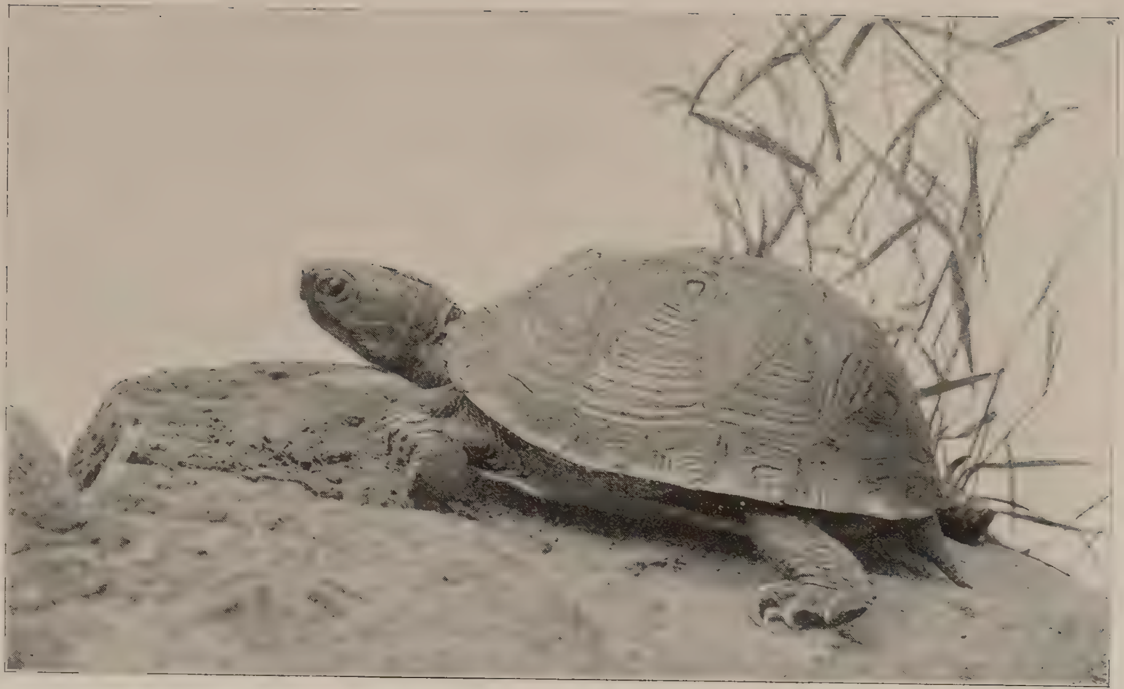

Fig. 39. *Cistudo carolina.*

Young Box-tortoise ; two-thirds grown. Reproduced from a photograph made by the Author.

years have designated these dermal scutes by certain names. Those of the median row are termed vertebrals *(v)*; the lateral rows are the costals *(co)*; while the ones round the border are called the marginals *(m)*. On the plastron, the dermal scutes are known as the gulars (Fig. 41); the postgulars *(pg)*; the pectorals *(p)*; the abdominals *(ab)*; the præanals *(pa)*; and the anals *(an)*. These scutes may be easily removed by the application of heat, or steam, or boiling, and then the white bones of the true carapace and plastron are exposed to our view for study. In the figures these are defined by the dotted lines, and are termed the costals *(co)*; the neurals *(ne)*; the nuchal *(nu)*; the pygal *(py)*; the marginals *(m)*; the entoplastron *(ent)*; the epiplastron *(ep)*; the hyoplastron *(hyo)*; the hypoplastron *(hyp)*, and the xyphiplastron *(xyp)*.

Young naturalists will have no trouble in acquiring these names, and they are of no little importance in the study of chelonians. In classification the arrangement of the bones and the dermal scutes is very convenient for the designation of species. To appreciate this fact, I would advise the student to secure in the market or elsewhere a small turtle of any species, and make out for himself the structures to which I have just invited attention.

In the big marine turtles found in different parts of the world, the same general arrangement of the scutes will be found to hold good. At the present writing I have at hand the carapace of a young Hawk's-bill turtle *(Caretta imbricata)*, and of it I made the sketch shown in Fig. 42. This is the upper view, and the lettering is the same as Fig. 40. The vertebrals and costals in *Caretta* always together number thirteen, and they are at once recognized by their peculiar imbrication, hence the specific name this species has received. The marginals form a serrated border to its carapace, as shown in the cut *(m)*. It is the Hawk's-bill turtle that furnishes the famous tortoise-shell of commerce, and owing to the demand for this, the animal is gradually being exterminated. The scutes are removed by suspending the living turtles over the fire until they start free from the carapace; they are then detached and the tortured turtle allowed to return to the sea. In this partly baked condition some doubtless survive, but many must die; but the only interest that this has for men is the fact that the scutes are probably never reproduced so as to even be fit for anything, or to be toasted off a second time. Chinese tortoise-shell, which is obtained from the Celebes, is the finest that comes to us, but the natives that collect it kill the turtles outright by knocking them on the head, and the dermal scutes are removed by boiling the shell of the animal in water. In the carapace of the young Hawk's-bill I have before me, it would hardly seem possible that the dermal scutes could be reproduced again, provided they were once removed, and the specimen survived the baking. This I judge from the fact that the outer halves of all the costals of the osseous carapace are quite rib-like in structure, and separated from each other by very considerable intervals. It is over these intervals that the imbricated costal dermal scutes are placed, and in their removal the visceral cavity of the animal would surely be left more or less unprotected and exposed.

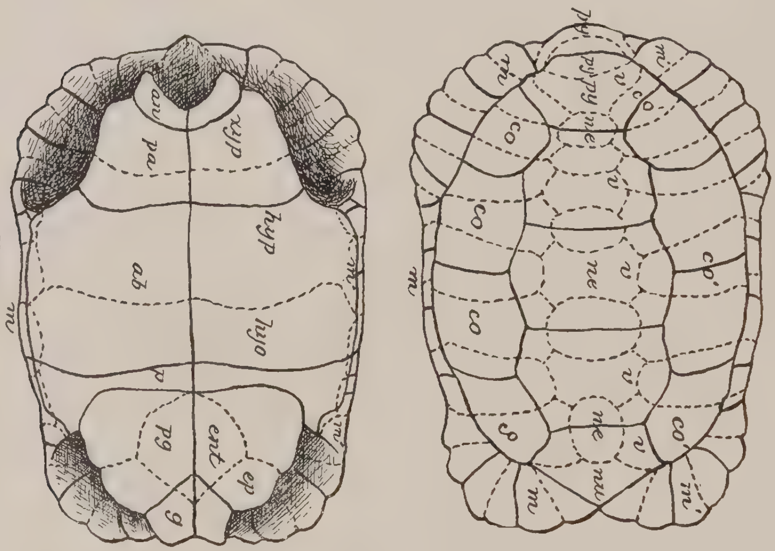

Fig. 41.

Fig. 40.

Figs. 40, 41. Shell of *Testudo pardalis.*

To show the divisions of the integument, which are marked by entire lines, and of the osseous carapace, these being marked by dotted lines.
Fig. 37. Upper or dorsal aspect.
Fig. 38. Lower or ventral aspect.
Dermal Scutes: *co*, costals; *v*, vertebrals; *m*, marginals; *g*, gulars; *pg*, postgulars; *p*, pectorals; *ab*, abdominals; *pa*, præanals; *an*, anals.
Bones of the Carapace: *co'*, costals; *ne*, neurals; *nu*, nuchal; *py*, pygal; *m'*, marginals; *ent*, entoplastron: *ep*, epiplastron; *hyo*, hyoplastron; *hyp*, hypoplastron; *xyp*, xyphiplastron. (Drawn by the author after Günther.)

Marine turtles, as before remarked, have their fore and hind limbs completely modified, so as to form paddles for swimming, and nothing I enjoyed more when sailing in the Southern seas than when I would occasionally observe a big green turtle *(Chelonia viridis)*, come to the surface to breathe. It is a beautiful sight to watch them and the marvelous rapidity by which they can propel themselves through the water is astonishing. They also have great command over their other movements, while on land they are as awkward and as helpless as any seal that ever lived.

Frequently I have eaten the eggs of the green turtle on the Bahama Islands, and found them very good, indeed. Upon one occasion I was much amused at a sailor with whom I was searching for turtle's nests, for when least expecting it he slipped into it through the sand, in which the coveted eggs were concealed by the turtle that laid them; and it may be imagined what his white trousers looked like after the accident. However the eggs were not all crushed, for nearly 200 were taken out in good condition.

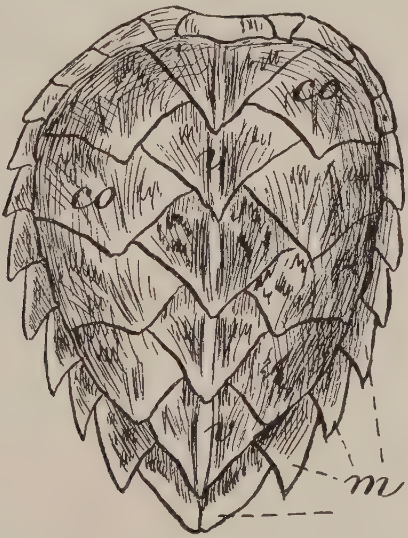

Fig. 42. The Carapace of a Young Hawk's-bill Turtle (*Caretta imbricata*).

v, vertebrals; *co*, costals; *m*, marginals. Seen from above and greatly reduced.

In 1883 while collecting in Louisiana for the Smithsonian Institution, under the direction of Professor Spencer F. Baird, I met with not a few different species of the fresh-water turtles of this country. Among these I succeeded in taking a few of the

Soft-shelled turtle *(Aspidonectes ferox* as well as *A. spinifer)*, a well-known species in many localities.

They are very ferocious, and difficult to find and capture. This is due to the fact that they are usually found in muddy water, either of the ponds or the rivers, and, being wonderfully quick in their movements, netting them was not an easy matter. My collectors rarely brought them in, and when they did I take it they caught the specimens by baiting for them. There was a druggist living in southern New Orleans in those days who had a young one of these soft-shelled turtles in a jar alive in his shop, and it was an extremely interesting form to study. It had the habit of settling itself down in the sand on the bottom of the receptacle, with no part of its body showing, save its snaky-looking head. Carnivorous and voracious in the extreme, it only required a tadpole, small frog or fish to come near it, when out shot its neck, as quick as thought, and the victim was seized in its rapacious jaws to be ravenously eaten in a trice. Big Soft-shelled turtles have the power, when searching for food in shallow water, to throw their entire body forward to seize upon it. These turtles are fine eating themselves, and many people prefer them even to the delicate green turtle, so long famous in the making of soups.

Günther adheres to the name *Trionyx* for this genus, and briefly describes some of them in his article "Tortoise" in the *Encyclopædia Britannica* (Vol. xxiii, p. 459).

In many of the city stores where birds, fish, and animals of all kinds are sold as pets we frequently see a tank containing many young turtles, ranging all the way in size from that of a nickel five-cent piece to that of a silver dollar. These are usually of four well-known species, viz., the Pond Terrapin *(Chrysemys picta)*; the Spotted Turtle or Peep-turtle *(Nanemys guttatus)*; the Snapping Turtle *(Chelydra serpentina)*; and the Musk Turtle *(Cinosternum p. pennsylvanicum)*. The first is known by the red and black alternate bars on the under marginal surface of the carapace; the second by the small orange spots sparsely distributed over the black surface of its dorsum or back; the third by its long tail, and its rough dermodorsal scutes; and the last by its smooth, light-brownish carapace, and the yellowish, longitudinal stripes on its head. Specimens of all of these and at all ages have been taken by me in various parts of the country from New England to the mouth of the Mississippi River.

A young Snapping turtle I recently had in confinement in a suitable vessel of water lived in apparent comfort without any food whatever for a period of three months. When food was partaken of by it (young snails) at the end of that time, the turtle died on the third day thereafter. Box-tortoises have been kept by me for a year, without food or water, and what is generally not known about this species, they are pretty good swimmers for short distances, and this power is frequently of advantage to them.

Many people in the country districts are in a habit often of keeping a Snapping turtle in the barrel of swill, where, in course of time, it naturally grows to be of great size; very tender; loses much of its normal musky odor; and, in short, becomes capital meat for the table, either to be made into soups or otherwise cooked.

The largest fresh-water turtle known *(Macroclemmys temminckii)* is related to the Snapping turtle, and is found in the rivers tributary to the Gulf of Mexico. It is often called the Alligator turtle from its being so ferocious, and its shell may attain a length of at least three feet. (Günther.)

We stand much in need of a fuller knowledge of many of the habits of our United States Chelonians, as well as their exact geographical distribution. In some departments of this subject we are indeed quite ignorant; knowing little or nothing about the breeding habits of many of the fresh-water species.

A good provisional classification for the *Chelonia* is found in Günther's article "Tortoise," to which I have referred above. It is largely based upon structural characters, especially those of the shell, as this part is so convenient. Little is known of the detail of morphology, or rather internal morphological detail, in many of the species. A good proportion of the existing families are represented by one or more fossil forms.

CHAPTER XI.

ALLIGATORS AND CROCODILES.

(*Crocodilia.*)

IN the Order *Crocodilia* we have a remarkable group of reptiles, representatives of which occur in various parts of the world. Naturalists divide the living crocodiles in three families, and these are known as the Gavials, the true Crocodiles, and the Alligators. In former ages of the earth's history, however, as has been pointed out by the writers upon the fossil remains of animals, there were not only a great many more different kinds of these reptiles, but they had a far wider range over the surface of the globe, and formed a more important figure in its fauna.

Restricted as they now are in their present distribution, it is safe to assert that the crocodiles and their near kin are marked as a declining group, and they will eventually be exterminated entirely. Anatomists have clearly shown them to be, by their structure, the highest order of reptiles now in existence, while literature of every description teems with accounts of them, both true and mythical, as far back as the very dawn of history; nor were figures of them by any means forgotten upon the monuments of the ancients.

Alligators are confined to America, and we have a very well known form of them in the United States, that occurs in all suitable localities throughout the South, being quite abundant in certain places. According to Professor Packard and other writers, we also have in Florida the Florida crocodile, described by Cuvier, the great French naturalist, as *Crocodilus acutus.* This reptile, which may attain to a length of fourteen feet, is rare upon the peninsula, becoming far more abundant in the West Indies and South America.

We may state here that the alligator and the crocodile are distinctly different structurally. In two points of external structure, this distinction is very well marked. In the alligator the fourth tooth, known as the canine or prehensile tooth of the lower jaw, fits into a pit in the upper jaw, whereas in the crocodile, or among the crocodiles, this tooth has, in the upper jaw, only a notch or furrow to accommodate it when the animal's mouth is closed. Again, the toes of the crocodile are almost completely webbed, being much less so in the case of the alligator, although the latter is doubtless just as good a swimmer. Finally, there is a jagged fringe of skin bordering the hind legs and feet of the crocodile, a development of doubtful ornamentation, that is not to be found in any alligator.

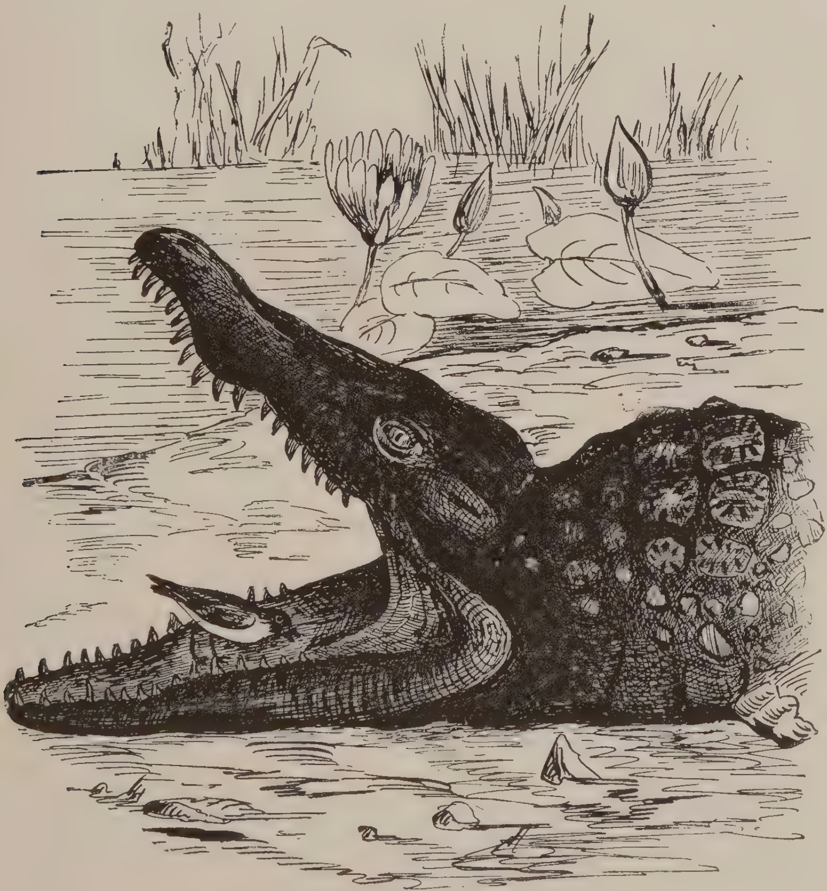

FIG. 43. HEAD OF CROCODILE.
(Drawn by the Author.)

This word alligator seems to probably have been derived from the Spanish, as a lizard, either big or little, is known to them as *el lagarto;* while in the South the writer has frequently heard the negroes speak of alligators as simply " 'gaters." In South America there are two or three more species of these reptiles known; the most conspicuous being the Caiman or Cayman, occurring principally in Guiana and Surinam; while in Brazil we find the Spectacled alligator or Jacaré. Either of these are representative of the genus to which they belong, namely, the genus *Caiman*, containing several species; and the genus *Jacare*, also including five or six species more.

It is said that the Caimans never grow to be as large as an alligator, nor are they ever so dangerous or voracious. Men are never attacked by them, either on shore or in the water, so long as the limbs are kept in motion. Caimans also differ from alligators in placing their eggs in a single layer, and for the utter neglect of their young after hatching. Now when a female alligator is about to lay, she first digs a deep hole in the sand, in which she deposits her eggs in layers, placing dry grass and leaves between each layer. In the United States this occurs, as a rule, but once during the season, as the eggs must be hatched out by the heat of the sun. Caimans on the other hand, although they lay each time a far fewer number of eggs, breed several times during the year; especially this is the case in the hottest parts of the region where they are found. A female alligator will watch and guard her nest of eggs until they are hatched, and then she immediately takes charge of the brood, affording them all the protection and care in her power. In these special traits they resemble the true crocodiles.

The female jacaré also deposits her eggs in a single layer, covering them likewise with leaves and straw. It is said that the vultures often scratch the eggs out and consume them; while a large number of the progeny are devoured by the adult males of this species. When the young first make their appearance it is usually at the hottest season of the year; food is scarce, and the marshes nearly all dried up. This conduces to make the males ravenous, and so their own young get the benefit of it, and are devoured whenever the female cannot sufficiently protect them against their fierce attacks.

The egg of this species are about the size of those of an ordinary goose, being, however, elongate and ellipsoidal in form. As in the case of all the *Crocodilia*, they are also white with a hard shell. The Indians of Brazil are very fond of jacaré eggs, and will also eat the flesh of the reptile itself, juiceless and musky as it is. Jacarés feed principally upon water-fowl and fish, and never touch any animal that they may by chance have destroyed in guarding their nest or young.

In suitable localities, along the banks of the Amazon, these reptiles may be often seen asleep—stretched out enjoying the hot sun in the day time; where, upon being disturbed, they quickly take to the water. At night they are both noisy and active, keeping to the water entirely, exposing only their heads as they swim about in search of their prey. Humboldt, in his South American travels, frequently saw jacarés basking in the sun during the day time " with open jaws, motionless, their uncouth bodies often covered with birds."

It has been said that our Florida alligator may attain a length of at least 18 feet, though the average adult rarely exceeds 15 feet. They are far more fierce and dangerous than their South American cousins, and will, whenever opportunity offers, attack both men and many quadrupeds. Strange to say, negro flesh is preferred above all other kinds by the alligator, and as a consequence these people are the avowed enemies of this famous reptile. Alligators get into the soft mud and lie dormant during the winter season. This fact is well known to the southern negro, and he unearths him from such places, with the double intention of destroying his enemy and obtaining his tail, which, cooked after their fashion, they esteem a great delicacy.

Many years ago when in Mexico, the writer heard, for the first time, the terrific roaring of the old male alligators. This occurred during the evenings, and especially during the mating season, when the forest-lined banks of the Coatzacoalcos River were made to resound with the harsh bellowings of this dreaded amphibian. The sounds emitted by a lot of bulls are no more to be compared to the concert of several of these than are the prattlings of so many babies to the boomings of a battalion of bitterns. Some say that they have even imagined that the very earth seemed to tremble beneath their feet when the performers were at no great distance off.

Although alligators are generally supposed to be polygamous, still during the pairing season the males engage in the most deadly combats, choosing the shallower parts of the elements in which they live as the place for the battle-ground. They work each other up to the fighting point by several not-to-be-despised taps with their tails. These increase in severity as the anger of the combatants begins to boil, and then the powerful jaws come into play,—and when they do take hold, the grip of the biggest vise is but the nip of a fiddler-crab to it. They do not rest satisfied until the victim is pulled beneath the surface of the water, and made away with.

A good observer of the habits of the alligator has said "on some occasions the alligators beset the mouth of some retired creek, into which they have previously driven the fish, bellowing so loud that they may be heard at the distance of a mile. To catch the fish they dive under the shoal, and having secured one, rise to the surface, toss it into the air to get rid of the water which they necessarily take in along with it, and catch it again in its descent. When, however, they succeed in capturing a land animal which is too large to be swallowed at a single mouthful, they conceal the body beneath the bank till it begins to putrefy, for as their teeth are not formed for cutting or masticating, they are unable to tear the tough flesh in its fresh state; it is then dragged on shore and devoured at leisure."

In the winter-time, in the most of our southern States where the alligator is found, especially in the more northern localities, it buries itself in the mud at the bottom of marshes and swamps, where it hibernates until the return of spring. If the season be an unusually severe one, they may in these situations become almost frozen, and it is said that, when in this condition, the reptile may be almost sliced into pieces without exhibiting any signs of life. If brought into a good warm place, however, this lethargic state is soon dispelled, and the fellow quickly resumes the power he possesses in the summer-time, and his wonted fierceness returns.

Bartram, one of the early naturalists in this country, a great many years ago, claims to have observed in a mineral spring near the Mosquito River, in Florida, great numbers of alligators and fish, although the water was nearly at the boiling point, and "strongly impregnated with copper and vitriol." In the opinion of the present writer, had the alligators been left out, this would at least have made a tip-top fish story.

Our alligator has a very formidable relative in Asia, known as the Gavial or Nakoo. As the species is principally confined to the River Ganges, it is best known as the Gangetic Gavial. They are easily distinguished from either alligators or crocodiles by their long and narrow jaws, furnished with teeth of uniform size, with the exception of the six anterior pairs, and by the male possessing a great swelling in front of the nostrils.

Gavials may attain a length of nearly 20 feet, and, as in the case of the South American jacarés and caimans, they are not dangerous to either man or beast. Their chief occupation consists in devouring the dead carcasses that find their way into India's great sacred river Ganges, and in this particular they perform a very useful office. Ælian, one of the historians of the ancients, knew of the existence of this reptile in the rivers of India, and he mentioned it in his writings as the crocodile that had a horn at the distal end of its snout.

Speaking of the literature of the group, however, the great bulk of it has been devoted to the true crocodiles. This, of course, is due to the fact that crocodiles of the Old World were known and written about long, long before America was even discovered or her alligators dreamed of by natural historians. In the manner of rearing their young, procuring and consuming food, methods of attack upon man and the larger quadrupeds, and, indeed, in their general habits, the crocodiles and alligators closely agree in all. Both the eggs and young have many destroyers, as birds, fish, turtles, man, and the male of the species—so that it is not likely that more than one young crocodile in forty comes to maturity, and this, far from the settlements of men.

Crocodiles when captured alive frequently feign death to a remarkable degree. Tennant, while traveling in Ceylon, I think, states that "on one occasion his party came upon a sleeping crocodile, which on being struck, after it had awakened and seen itself surrounded, lay perfectly quiet and apparently dead; in a little while it was seen to glance furtively about, and then make a rush towards the water. On receiving a second blow it again feigned death, and this time no amount of poking could elicit the slightest sign of life, until a lad, by gently tickling it under the fore leg, caused the reptile so far to forget itself as to draw up its limb."

An alligator, or a crocodile, can go a whole year without eating or drinking, a feat that can be performed in a lesser degree by most lizards, as the writer has often proved. The crocodile resorts to numerous stratagems to secure its larger quadrupedal prey, and, as it has a most formidable weapon at either end of its body, the probabilities in favor of certain statements, whether authenticated or not, are simply doubled. A blow from its tail will knock down and stun a big animal, while a powerful lever will not force its jaws apart when once it has taken a good hold.

Prevalent among the myths about crocodiles is the one that states the reptile never ceases to grow, and consequently the limits of its size and age are not exactly known.

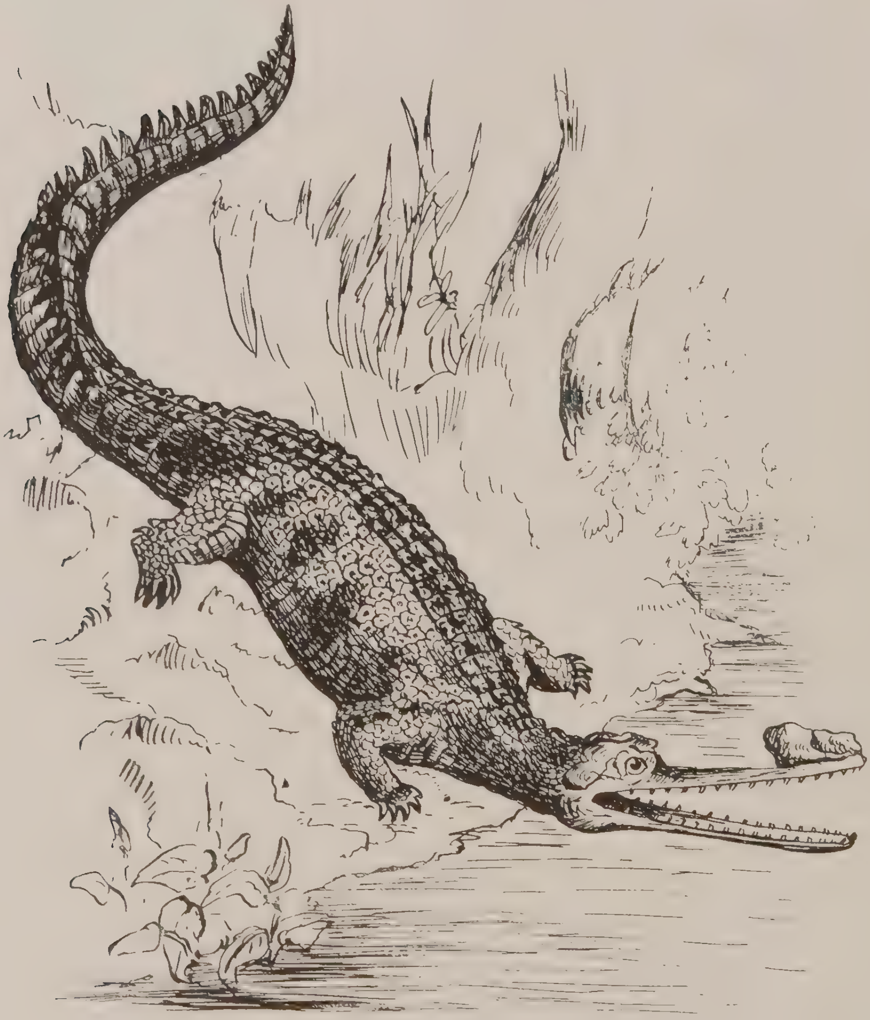

Fig. 44. The Gavial.

Drawn by the Author.

Ever since the days of Herodotus, it has been known that the crocodiles of the Nile, in Africa, frequently lie basking in the sun, with open and wide-gaping mouths, while a small species of plover is allowed by these great reptiles to enter and feed upon the parasitic worms in its tongue, thereby affording no small relief. This fact is illustrated in Fig. 43 of the present chapter. The plovers belong to a group known in ornithology as Coursers, and they are forms of great beauty. Sometimes, on the Upper Nile, it is not an uncommon sight to see an old crocodile in the water, looking for all the world like a floating log, with two or three of these pretty plovers disporting themselves upon its back. They have a peculiar note to alarm the sleeping and ponderous amphibian, in the event of approaching danger.

On the Lower Nile the crocodiles have been rendered nearly extinct; man has shot them out. In the same locality, in ancient times, the Egyptians held them to be sacred; they kept many of them tame, feeding them in the most extravagant manner, and ornamenting many parts of their bodies with gold bracelets, jewels, and precious stones. Thus decked out, they were worshiped by the people. Many were brought to Rome, especially in the time of Augustus, where they were introduced at the Amphitheater. Temples were raised at Memphis in the reptile's honor, and in them, as in other cities too, living crocodiles were kept as divinities. After death they were mummified with the utmost care and regard. In other parts and cities of ancient Egypt, however, the very opposite sentiments obtained, and crocodiles received no mercy at the hands of the inhabitants. Many natives in Africa eat them with great relish, but Sir Samuel Baker regarded the flesh with the utmost disgust.

To return to our own crocodile and alligator, I may say that a full knowledge of their breeding habits has as yet not been secured by science, so that accurate observations by any naturalists will be very acceptable, and constitute a positive contribution to a remarkable form of reptile that sooner or later must utterly disappear from this country.

CHAPTER XII.

GREBES, LOONS, AND AUKS.

(Pygopodes: Alcæ.)

SO far as my observation goes, it is only the better informed, or else those who have some knowledge of ornithology, apart from professional naturalists, who apply the name "Grebe" to the birds so designated in science. As a rule, the representatives of this family are popularly called "divers" or more often "hell-divers," and sometimes "waterwitches," or "dippers," and the little Pied-billed Grebe *(Podilymbus podiceps)*, probably the best-known form of all the genera, not only has all these names applied to it, but likewise in the vernacular tongue passes under the other ones of "dab-chick," "die-dapper" and the like.

It is not so very long ago since the present writer paid considerable attention to the osteology of these birds as well as to that of many of their relatives, both near and remote. These studies led me to believe that the Grebes have their nearest allies in the Loons, and that they each constitute a superfamily; the first-mentioned birds forming the *Podicipoidea*, and the latter the *Urinatoroidea*. Taken together these two superfamilies form the suborder *Pygopodes*. In a paper I recently published in London upon this group, I remarked that formerly the *Pygopodes* were considered by a number of ornithological systematists to be a group of birds containing but one family—the *Colymbidæ*, embracing, in this country, at least, all those species known to us as the Grebes and Loons. By some this group was placed in the old order NATATORES, which was created in times gone by, to contain nearly every kind of water-bird, from a Flamingo to an Auk. Even as late as 1839 Brandt* included the Penguins in this order, and prior to his day Illiger had associated the Phalaropes with them. Passing by these earlier taxonomies, we find the writers of the later years of the present century removing group after group from this natatorial assemblage, so that at the present time the majority of avian classifiers place in the order Pygopodes only the Auks, Grebes, and Loons. Mr. Sclater has committed himself to the opinion that the Pygopodes "seem to form

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* Beitrage zur Kenntiss der Naturgeschichte der Vogel.

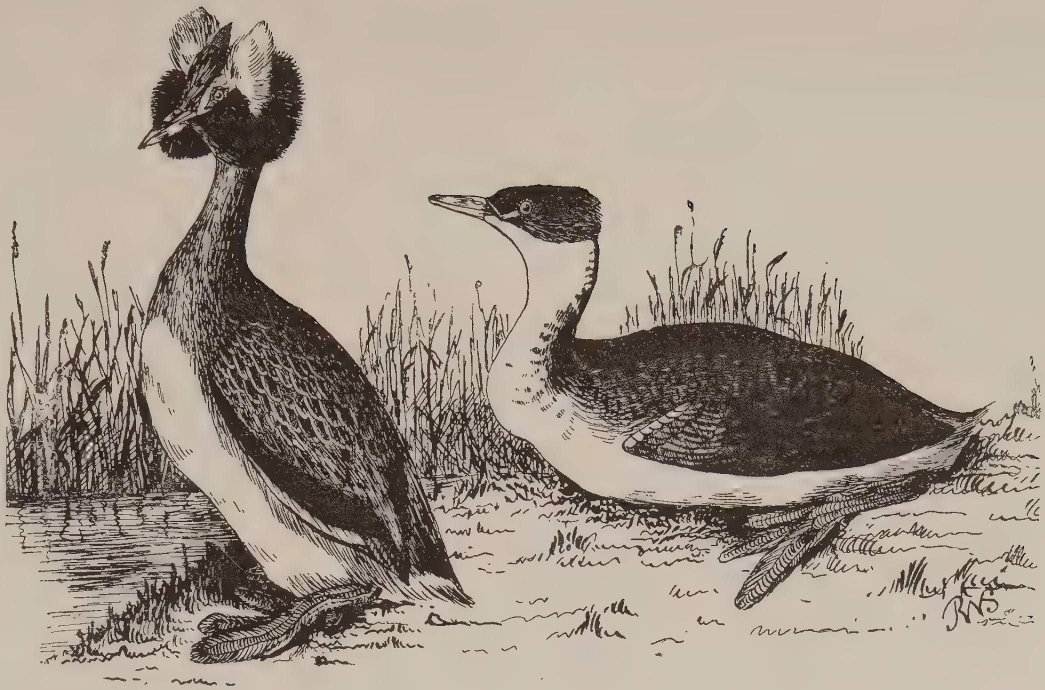

Fig. 45. The Horned Grebe.

Standing up is an adult male in full spring plumage; the other is a young bird shot in December. Drawn by the Author after Audubon.

a natural transition between" the Gulls and the Penguins; and to my friend Professor Alfred Newton "it appears questionable whether the Grebes, *Podicipedidæ*, have any real affinity to the two families *(Colymbidæ* and *Alcidæ)* with which they are usually associated, and this is a point deserving of more attention on the part of morphologists than it has hitherto received."

Within the confines of the United States we find no outlying types in her avifauna to this group *Pygopodes*, when constituted as I have above suggested—no bird-forms about which the morphologists have any doubt as to whether they belong to this suborder or not; and I conceive that such forms, among other avifaunæ, as we find in the genera *Heliornis* and *Podica*, are too unmistakably stamped with ralline characters, according to recent investigators of their anatomy, to ever be associated again with the Grebes, much less with the Loons.

The present writer is of the opinion that both the Grebes and the Loons are the descendants of a now extinct ancestral stock of birds, from which those remarkable fossil forms of toothed divers of the cretaceous beds of Kansas described by Marsh—the *Hesperornithidæ*—were an offshoot. If we designate that ancient stock as the *Hesperornoidea*, I conceive them to have been forms possessing ample powers of flight and swimming—in short, ponderous flying divers with teeth in their jaws. From those birds it is probable that such types as *Hesperornis regalis* and *H. crassipes* were a branch, in later time, that for some reason or other ceased to resort to flight, lost their wings in consequence, but became divers of enormous power.

From a consideration of the osteological characters, I consider the Grebes to be an earlier offshoot of the pygopodous stem than the Loons, and more nearly related to *Hesperornis* than are the latter birds. The morphology of the pelvis and the pelvic limb, as well as certain characters in the skull and trunk skeleton, point in favor of this view, I think. So far as the affinities of the *Pygopodes* are concerned with other groups of existing birds, I have shown in other places that they present a number of osteological characters exhibited in common with the Auks and their allies *(Alcæ)* and the Gulls *(Longipennes*, etc.). More with the first, and more or fewer with the latter groups.

The following list gives the genera, species, and subspecies of grebes that are now recognized as occurring in various parts of the United States, viz.: The Western grebe *(Æchmophorus occidentalis)*; Holbœll's grebe *(Colymbus holbœllii)*; the Horned grebe *(C. auritus)*; American eared grebe *(C. nigricollis californicus)*; the St. Domingo grebe *(C. dominicus)*, and the Pied-billed grebe *(Podilymbus podiceps)*. Other forms of these birds are found in many parts of the world, and at least five distinct species occur in Great Britain. Many of the habits of these birds are characteristic of all the members of the group, and are well exemplified in the Horned grebe, of which I present a figure, and which will be the species chosen for the purposes of description. In suitable localities, this grebe is found to inhabit the entire northern hemisphere, and in this country breeds from northern United States northward. During the breeding season, the head of one of these birds is ornamented with a very handsome full tuft of feathers, of a rich black, with glossy greenish reflections. This is set off by the remainder of the crest being of a deep chestnut, and with a yellowish stripe over each eye. As in all grebes, the lower parts are of a glistening white, the plumage being very dense, while its upper parts are for the most part of a brownish black. The wings are of a chocolate brown, with the secondary feathers white. Its irides are of a bright carmine, and the bill black, tipped with yellow. Its neck and sides are of a purplish tint, which becomes mixed with dusky on the flanks. In its winter plumage the bird becomes far less conspicuous by the nearly complete absence of the head ornament, and much of the general coloration becoming plain black and white, as shown in the figure. Fledglings have their heads curiously striped with white, gray, and rufous, and are expert divers from the very first, as is the case with all grebes. This bird has a length of about fourteen inches, and an extent of two feet, it being of medium size as compared with other species of the family. Usually, they select the shores of ponds as their breeding places, constructing the nest at the water's edge, or a few feet distant from it on the broken-down rushes or other vegetation found in such localities, and it is of this same material, too, that the nest is built, it being rudely interwoven and piled up for several inches with a shallow concavity on top. Sometimes, the waters of the pond rising, due to heavy rains, these rude nests are floated, but I doubt that the birds ever build them so originally, as has been stated by some writers. When the parent leaves the nest for any purpose, and has the time to do so, it makes a practice of covering the eggs over with loose weeds and grass, so as to nearly or quite conceal them from view. A set of these usually numbers from six to eight, being smooth, unmarked, plain, and of a whitish color, or creamy. They are elongated or of an ellipsoidal form.

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* Encyclo. Brit., 9th ed., vol. XVIII, art. "Ornithology," p. 45.

The Horned grebe is a bird of powerful flight, and during the seasons of migration makes long aerial journeys, often at considerable heights. On land, however, he is an awkward fowl, with a waddling locomotion, and when at rest generally assuming the erect attitude with his curiously lobed feet spread out in front of him, and the body supported on the backs of the tarsi and on the distal end of the body—the true feathery tail being absent and represented only by a downy tuft, quite rudimentary in character. Nestlings, when placed on the ground, crawl about in a peculiar manner, reminding one very much of the action of bats under similar conditions. Many years ago, when out in a boat shooting on a lake in Wisconsin, I came upon several of these grebes in an open space among the reeds near the shore. One or two of them dived, but their companions quietly sank in the water until only their beaks were to be seen above that element, and in this position they stealthily swam into the denser vegetal growth of the border of the lake. Nearly all grebes resort to this peculiar means of making their escape when thus alarmed. They will dive, and as quick as a flash, at the slightest provocation, thus often rendering them difficult birds to kill even with a gun. These dives often extend for some considerable distance, and they pop up again at the most unexpected places. Grebes feed upon small fish, frogs and reptiles, as well as the seeds of certain water plants, crustacea and aquatic insects. In speaking of the Horned grebe, Audubon has said: "I have observed in the stomachs of almost all that I have examined, a quantity of hair-like substances rolled together like the pellets of owls, but have not ascertained whether or not these masses are disgorged. They certainly cannot pass through the intestines. But unless birds of this kind are kept in an aviary and watched, this matter must remain unknown." This question is not referred to in any other ornithological work the writer happens to have at hand at this moment, and it would seem to be one into which an examination would not be altogether uninteresting.

Our loons are all of the genus *Urinator*, there being five species of them. These species are known as *Urinator imber*, the Loon;

U. adamsii, the Yellow-billed Loon; *U. arcticus*, the Black-throated Loon; *U. pacificus*, the Pacific Loon; and *U. lumme*, the Red-throated loon. They are all markedly handsome birds; that is, the males in breeding plumage are, and although they have habits very much alike in all the species those habits are frequently found to be very interesting. Both in America and the Old World loons are widely known as divers—the Great Northern diver being the name frequently applied to the largest species that has a black bill *(U. imber)*. As a rule they far exceed the grebes in size, but like them their legs are placed almost at the extreme posterior end of the body, and they have short wings and tails. Unlike the grebes, however, the toes of loons are entirely webbed in front, instead of being lobed, and there are a number of other anatomical differences distinguishing the two families.

All the loons have excellent powers of flight, but they are most at home in the water, in which element they are divers of the utmost expertness and endurance. On shore their locomotion is of an exceedingly clumsy character, they merely being able to push themselves along on their breasts by means of their legs. As they build their nests on the ground, sometimes as far as thirty or forty yards from the water's edge, of either some lake or marsh, their mode of progression has the effect of making a regular path to and fro from the nest to the water. They generally lay but two eggs, and these have been described in general terms as being of an elongate-ovate form, deep brown or olive color, and somewhat sparsely spotted or speckled over with a darker brown or black spots. Newton says: "The divers live chiefly on fish, and are of eminently marine habit, though invariably resorting for the purpose of breeding to fresh-water lakes, where they lay their two dark-brown eggs on the very brink; but they are not infrequently found far from the sea, being either driven inland by stress of weather, or exhausted in their migrations." Further on, in speaking of their flight, he observes that it "is strong and they can mount to a great height, whence on occasion they will rush down with a velocity that must be seen to be appreciated, and this sudden descent is accompanied by a noise for which those who have witnessed it will agree in thinking that thunder is too weak an epithet."

All the loons have a loud and penetrating cry, which in the Great Northern diver is peculiarly harsh, clear, and resonant.

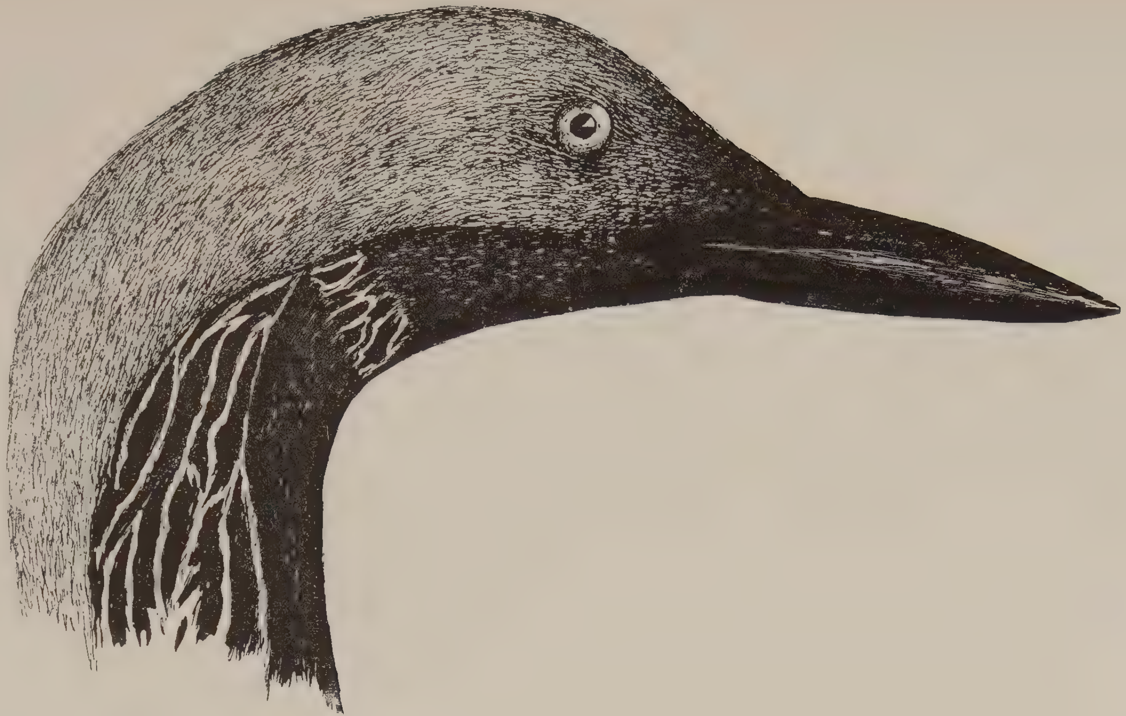

FIG. 46. RIGHT LATERAL ASPECT OF THE HEAD OF THE BLACK-THROATED DIVER (*Urinator arcticus*).

Drawn by the Author, two-thirds life size,

This appears to be especially the case before a storm, and old sailors on our coast, who are very familiar with it, claim that they know when a tempest is approaching by observing the restlessness of the loons, and the vigor with which they utter their notes at such times. It is said that this shrill scream of the loon can be heard at a distance of a mile or more from the vessel, a statement we can very easily believe. Years ago, or in 1868, when the present writer was collecting water fowl on the lakes of Wisconsin, he distinctly heard the cry of the Great Northern diver at even a longer distance than that, for when the air was clear and motionless, its sound was carried to the ear nearly across La Belle Lake, at a point where it was over two miles wide.

In a brief chapter, such as the one we are now writing must necessarily be, it is quite out of the question to attempt to offer descriptions of the beautiful plumages of all our species of divers; for those the reader must be content to refer to any one of our now many excellent standard works upon descriptive ornithology. Nevertheless with respect to this part of our subject, I would fain invite attention to the exquisite plumage of the male of the Black-throated diver. There is a magnificent mounted specimen of this bird, with others of the same family, in one of the cases at the Smithsonian Institution at Washington. In conversation with Mr. Ridgway the other day—the curator of that department—he informed me that that species was now very rare in our avifauna, and the Institution possessed but a few mounted examples, with no skins. He kindly placed at my disposal the individual in the case, and I made an accurate, life-size sketch of its head, the reproduction of which, one-third reduced, is shown in Fig. 46 of this chapter.

The bill of this species is black, while the irides of the eyes are a bright red. Behind, the neck is a clear gray which gradually deepens as we pass to the top of the head and about the eyes. In front, the neck is black with purplish reflections, and this region is divided by a transverse bar of black and white feathers. Below this, on the sides of the neck, somewhat similar black and white longitudinal bars form a distinct area. Above, the bird is black with greenish reflections, shading to brown behind. Longitudinal areas of white spots embellish this region—two upon each side. The lower parts are white. Young divers of this species are different, but the females resemble the males though smaller in size. An old male will measure nearly 30 inches in length.

Audubon says: "I once caught one of these birds on the Ohio, it having been incapacitated from diving by having swallowed a large mussel, which stuck in its throat. It was kept for several days, but refused food of every kind, exhibited much bad humor, struck with its bill, and died of inanition. The food of this species consists of fish, aquatic reptiles, testaceous mollusca, and all sorts of small crustaceous animals. Its flesh resembles that of the loon, and is equally unfit to be eaten."

Audubon figures the male, female, and young of this species, as he does the Loon and the Red-throated diver. These were all the forms of *Urinator* known to him at the time he completed his great work, as occurring in our waters. Since his time both the Yellow-billed loon and the Pacific loon have been added. His account of the Great Northern diver is one of the best that has ever been written, and like a good story I have read it many times at varying intervals, but always with the same interest.

Some authorities group the auks along with the divers, making the two families constitute the *Pygopodes*. But such an arrangement is not borne out by their morphology, and in my classification of birds, I have long ago abandoned it as being unnatural. Indeed, some forms of auks are more nearly related to the gulls *(Longipennes)* than they are to the loons and grebes, as a study of their osteology plainly shows. In short, I make a suborder for the auks and their immediate allies, designating them as the *Alcæ*, as has been done by Sharpe and others. They are birds more or less confined to the circumpolar regions, rarely occurring to the southward. In our United States avifauna they are represented by the puffins, the auklets, the murrelets, the guillemots, the murres, the auks proper, and the Dovekie. Of these several genera the genus *Uria* or the murres are the most nearly related to the gulls of all the *Alcæ*, while the famous extinct Great Auk was the most lowly organized species of the group and should be awarded a place in accordance in future schemes of avian classification.

As is well known, the literature and the published figures of the Great Auk are both very extensive, and no doubt every one who will read the present article is more or less familiar with its history. A number of years ago the Smithsonian Institution had collected on the Funk Islands a great quantity of the bones of the

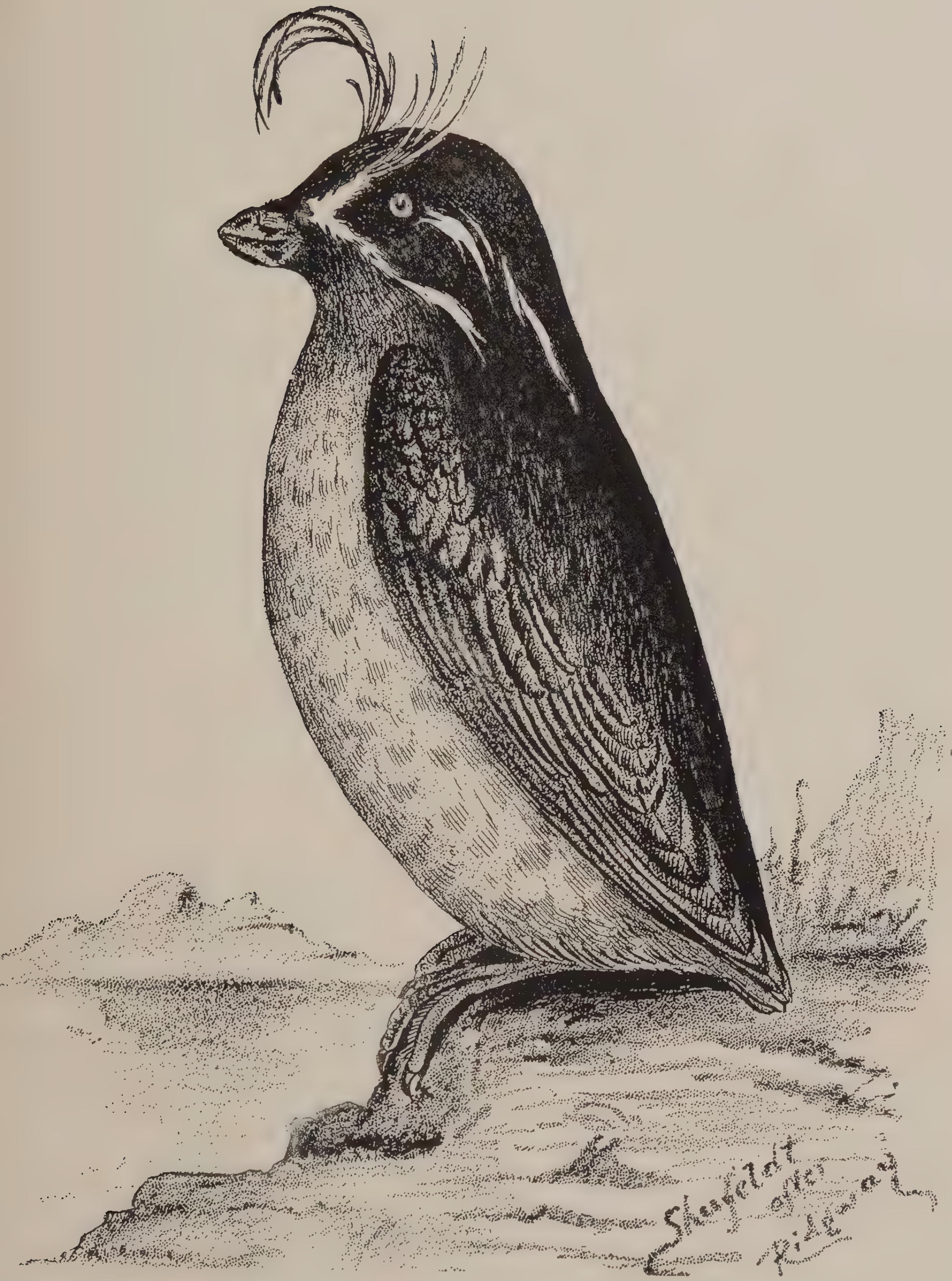
Shufeldt after Ridgway

FIG. 47. WHISKERED AUKLET.

Adult in breeding plumage.

Great Auk, and it will be remembered that it was upon these islands that this bird was known to be last alive on our shores. Of all existing Auks perhaps the species as near related to the Great Auk *(Plautus impennis)* is the Razor-billed auk *(Alca torda)*, a form which is abundant upon certain of the islands and parts of the coasts of the North Atlantic, and which in winter may sometimes be found as far south as southern New England. An adult specimen of this auk has a length of about eighteen inches and an extent of twenty-seven. During the summer months both the bill and the feet are black, the former having an oblique white line across each mandible. The mouth within is a bright yellow. Audubon, who examined many fresh specimens, says the iris is deep hazel; others state that it is bluish. All the lower parts are white, as is also the lower part of the neck in front. For the rest of the general plumage they are black, tinged with deep brown and green. From the bill to the eye, upon each side, runs a narrow line of white; the tips of the secondaries are also white, the rest of the wing being a deep brown. The sexes are alike, but the young are duller and mottled with white about the sides of the head and throat. These auks are good flyers, swimmers, and divers. They live largely upon shrimps and other marine animals. With other *Alcidæ* they breed in the fissures and other apertures among the high rocky cliffs of their northern home. The eggs, one or two in number, are generally laid in May or June.

Another very interesting auk, one of the smaller species, which rightly claims a place in our avifauna is the Dovekie *(Alle alle)*. This bird is found upon nearly all the coasts and off-lying islands of the North Atlantic ocean and Arctic seas, where it breeds. In the winter-time it has been found as far south as New Jersey. A male of this species has a length of something over seven inches, having a black bill, hazel irides, and flesh-colored feet. The head and all the upper parts are of a glossy blue-black, while below the bird is pure white. The female has the throat white in winter, and the black is considerably duller. The eggs of the dovekie are two, being of a pale greenish-blue color.

When it occurs off our coasts in the winter, it is sometimes blown inland during heavy storms, but this is by no means frequently the case.

We also have interesting genera in our auklets and murrelets, which are represented by at least a dozen species—too many indeed to attempt to describe in the present chapter. Most of these are to be found in the North Pacific and are nearly entirely absent from the Atlantic ocean. In size they range all the way from the Least auklet *(Simorhynchus pusillus)*, which has a length of about 6.50 inches, to the Rhinoceros auklet *(Cerorhinca monocerata)*, which has a length of more than fifteen inches. They also vary most remarkably in appearance, plumage, and general character, especially in the extraordinary changes that are undergone by the bill during the breeding season, and of certain ornaments about the eyes in some of the related species (puffins). About sixteen years ago these changes were closely studied and ably described by the eminent French naturalist, Louis Bureau, who showed the times and methods of moulting of these peculiar horny appendages. All these birds are excellent flyers, and swim under water with the greatest possible facility. During the breeding season they are highly gregarious, and congregate in millions at their breeding stations—the rocky islands of their northern home. They lay from one to three eggs, are supposed to be monogamous; and these exclusively marine fowlets have no notes beyond occasional harsh cries. They all subsist upon such animals, as small fish and crustacea, they capture in the sea. In the summer many of them possess handsome crests and plumes upon the top or the sides of the head, and the young when first hatched are covered with down, which is long and soft. During the year they assume a plumage which differs from their parents, and the latter also have, as a rule, a different winter and summer dress. In order to give the reader an idea of the appearance of an adult specimen of one of these auklets in breeding plumage, I present a drawing of the Whiskered auklet *(Simorhynchus pygmæus)*, which I copied from a colored plate of Ridgway's, illustrating Turner's "Contributions to the Natural History of Alaska" (p. 120). These little fellows are very clumsy walkers on the land, and some of the species but shuffle about in the most helpless manner imaginable. At rest they stand erect from the fact that their legs are placed at the posterior extremity of their bodies.

Other species of the suborder we have under consideration are seen in the murres and guillemots of the genera *Uria* and *Cepphus* respectively, there being about three representatives of the latter, and four of the former genus. As a rule they are very different appearing birds as compared with the

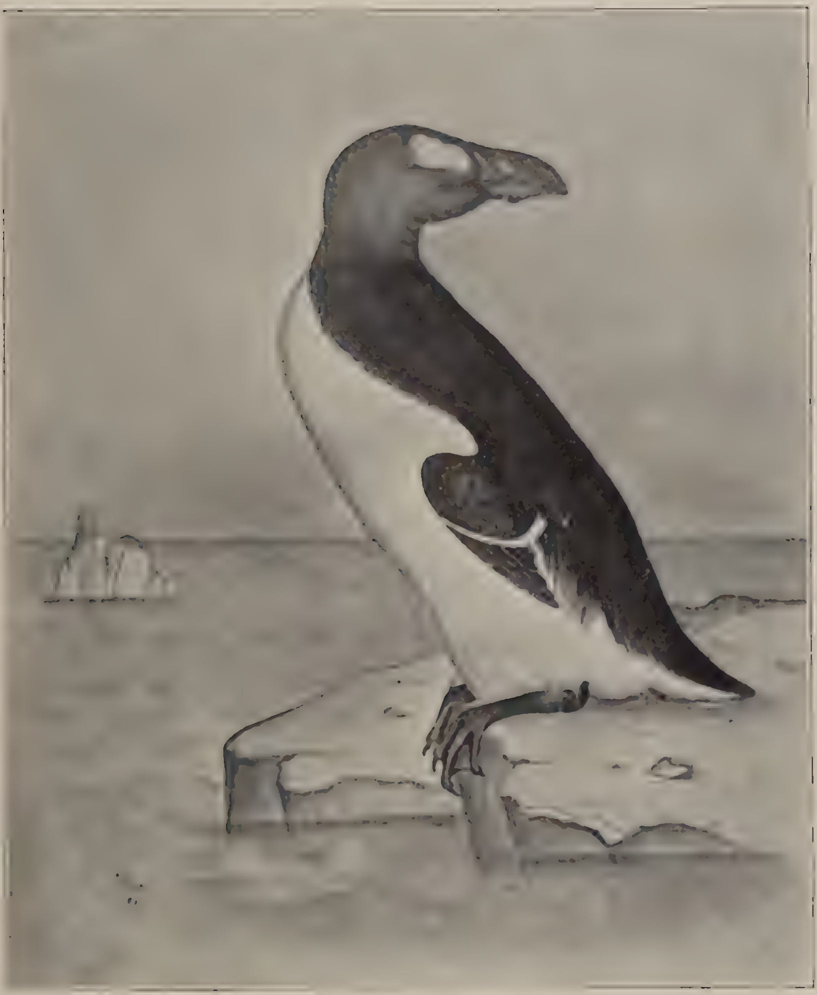

FIG. 48. THE GREAT AUK (*Plautus impennis**).

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*In *The Century Magazine* for January, 1886 (pp. 352–365), I published an article entitled "Feathered Forms of Other Days," illustrated by a number of figures, and among them one of the Great Auk, it being a copyrighted copy of my original painting of that famous bird. Century Company having declined to loan me an electro for the figure published by them, I was compelled to make a photograph of my original, and figure 48 (above) is the half-tone reproduction of that photograph.

The Century figure appeared reduced under the word *Alca* in *The Century Dictionary*, where it is stated that I copied my Figure from Audubon. Such, however, was by no means the case, and whoever it was that compiled the ornithological articles of that great work, either was not familiar with Audubon's figure of the bird, or else no artist – or both. In making this drawing I used the mounted specimen of the Great Auk in the Smithsonian Institution chiefly as my guide and model, and made use of the Audubon plate only in part.

Fig. 48 then is a fac-simile of my original, and appears now for the first time. R. W. S.

auklets and murrelets, especially the first-named. This fact will at once be appreciated by turning to the best known form among the guillemots, namely the Black guillemot or Sea Pigeon *(C. grylle)*. When in full breeding plumage, the adult of this species is a sooty black bird, the feathers being tinted or tinged with green in certain lights. The wings, tail, bill, and claws are all black, the wings being ornamented with a large white area upon each surface. Its feet and mouth are bright red. This plumage only lasts a short time and the seasonal changes for both young and adult are marked. Black guillemots occur on the North Atlantic, European and American coasts. A great deal has been written about the murres which are found in the same localities with the last. This is the common murre *(U. troile)*, and myriads of these " congregate to breed on rocky islands, incubating their single eggs as closely together as they can find standing room on the shelves of the cliffs; their ranks serried on ledge after ledge, and clouds of birds whirling through the air. The eggs, so numerous as to have commercial value, are notorious for their variability in coloration." Brünnich's murre *(U. lomvia)* is also found upon the coasts and islands of the north Atlantic and eastern Arctic oceans, while in similar localities of the north Pacific and western Arctic oceans, these two species are represented by the California murre *(U. t. californica)* and Pallas's murre *(U. l. arra)*.

Finally in the suborder *Alcæ* belong the puffins, and these are placed in two genera, viz., *Lunda* and *Fratercula*. They are remarkable, big-billed auks of grotesque appearance, very different from any of the other members of the group. When on the land they stand well on their feet and do not squat down as other auks do. The Tufted puffin *(Lunda cirrhata)* and the Horned puffin *(Fratercula corniculata)* are found in the north Pacific; only stragglers of the former having been occasionally taken on the coasts of Maine. From Spitzbergen to Baffin's Bay we find the Large-billed puffin *(F. a. glacialis)*, while the Common puffin *(F. arctica)* is the north Atlantic representative of this subfamily.

Among their structural peculiarities the puffins are noted for their remarkable bills, for naked and skinny rosettes at the angles of the mouth, and for curious appendages over and below the eyes. As a rule the bill is about as long as the head, triangular on lateral aspect, greatly compressed from side to side, and as deep as it is long. It is, during certain seasons of the year, incased with bright colored, horny, deciduous elements, that are regularly moulted. The history of this peculiar moult is extremely interesting and varies in the different species. The sexes are alike, and their plumage does not exhibit much seasonal change. They lay their single egg in the crevices of the rocks or in burrows in the ground. *Lunda* lacks the horny appendages about the eye, but has pendant tufts of silky, straw-colored feathers at the sides of the head.

The Common puffin has the " throat and sides of the head white, that color extending over the eye and passing in a narrow line behind the occiput. Upper part of the head blackish gray, tinged with olive, paler anteriorly. The middle of the neck all round, and all the upper parts of the body, deep black, with blue reflections, the quills tinged with brown. The whole under surface white, except the upper parts of the sides, which are dusky." It has a length of about 13½ inches. Audubon, from whom I quote this description, gives us quite a long and very interesting account of this species. But the natural history of these extraordinary birds would make a very extended chapter, and occupy far more space than can be devoted to the subject here, as much as the writer would like to enlarge upon it.

CHAPTER XIII.

GULLS AND THEIR ALLIES.

(Longipennes.)

THE transition from the Auk group to the Gull group is easy and not far to seek. If one will take the skeleton of any one of the typical Murres *(Uria)* and critically compare it with the skeleton of a typical Gull *(Larus)*, it at once becomes evident that the two genera, although belonging to different suborders, are not by any means so far separated but what the relationship is easily recognized. Other structures than the skeleton give support to the facts derived from a comparison of this kind. Now the Gull group constitutes the suborder Longipennes, and so far as our American avifauna is concerned, it includes representatives of the skuas, the jaegers, the gulls, the terns, and the skimmers. But one skua is known to occur upon our coast—the common one *(Megalestris skua)*, and but three jaegers, all of the genus *Stercorarius*. The gulls are far more numerous, and are represented by a number of genera, as *Gavia*, *Larus*, *Rissa*, *Rhodostethia*, and *Xema;* including in all nearly thirty species, the vast majority of which belong to the genus *Larus*, which is the typical one. Terns are not quite as numerous as the gulls, but there are still nearly twenty species of them belonging to our fauna. They are distributed through the four genera *Gelochelidon*, *Sterna*, *Hydrochelidon*, and *Anous*, most of them belonging to the more typical genus *Sterna*. Finally, in an entirely distinct family, we have the Black skimmer *(Rynchops)*.

At different times during the past few years the present writer has made extensive comparative studies of the morphology of this group of birds, and especially of their osteology, and from these investigations has been led to the opinion that the following scheme of classification expresses the relations of these birds to each other within the suborder.

- LONGIPENNES........
  - Laridæ..........
    - *Larinæ*
    - *Sterninæ*
  - Stercorariidæ.
  - Rynchopidæ.

So far as anatomy goes, and to some extent habit and appearance, the gulls merge almost insensibly into the terns, as, for example, the gull known as Sabine's gull *(Xema sabinii)* is quite nearly related to such a Tern as the Arctic tern *(Sterna paradisœa)*, while on the other hand the Gull-billed tern *(Gelochelidon nilotica)* more or less nearly approaches some of the stouter-formed gulls of the genus *Larus*. As for the Black skimmer *(Rynchops nigra)*, I have elsewhere called attention to what is by no means either an uninteresting nor insignificant fact, that in some parts of its osteology it bears a striking resemblance to that

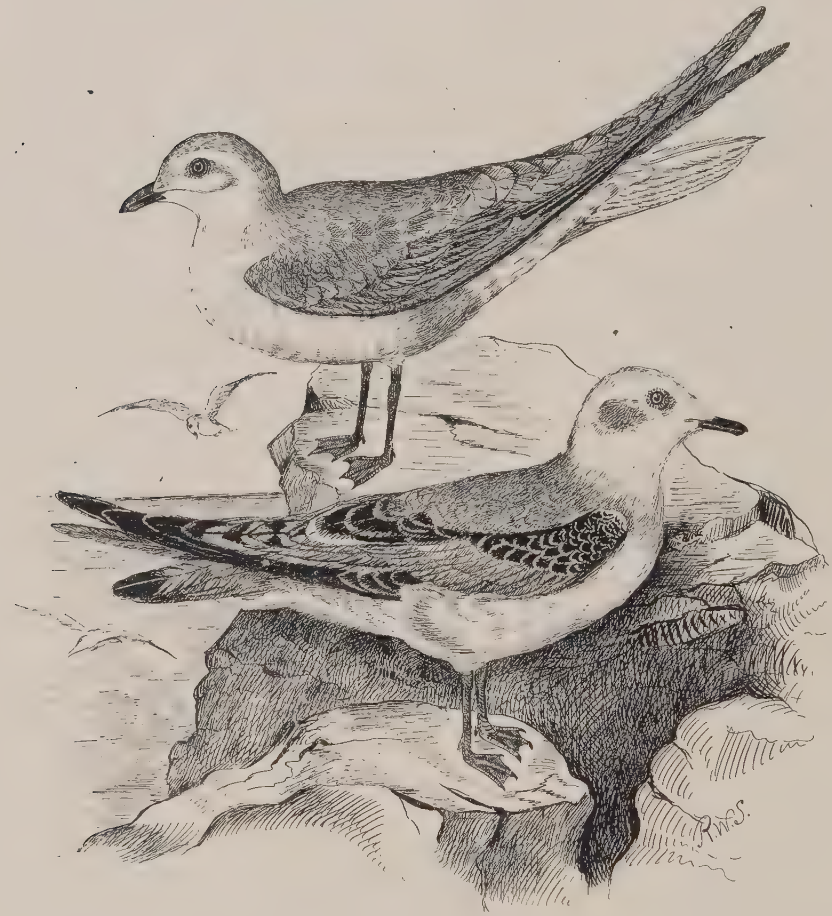

FIG. 49. ROSS'S GULL (*Rhodostethia rosea*). (Reduced.)

The upper figure is an adult male in winter plumage; the lower one, a young female of the first autumn. Drawn by the Author.*

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[*] In making this drawing I was assisted by the two plates (colored) of Mr. John L. Ridgway, illustrating the "Report of the International Polar Expedition to Point Barrow, Alaska," by Lieut. P. H. Ray, U.S A. (Government).

remarkable extinct cretaceous bird *Ichthyornis*, of which several species have been found. Heretofore the Black skimmer has been very generally considered by ornithologists to be but a sort of a tern with a different kind of a head; but this is by no means the case, for if any one will take the pains to structurally examine an example of this species, he will soon be confronted by the fact that, instead of being but a "modified tern," it is separated from the other longipennine families by gaps of no mean width. In other words, it is a very distinct family. The skuas and jaegers stand between the *Rynchopidæ* and the *Laridæ*, and from what has just been said we are prepared to learn that they are far more closely allied to the latter than they are to the skimmers. We have already stated above how this gull group is allied to the auks, and upon carrying our investigations still further we can find no objection to Huxley's observation, that "the gulls grade insensibly into the *Procellariidæ*," while, on the other hand, my own studies fully convince me, in so far as their osteology goes, an even closer relation exists between the gulls and the representatives of the great plover group of birds, or the *Limicolæ*. The *Procellariidæ* are generally considered to include such families as the albatrosses, the fulmars, the shearwaters, and the petrels; and of these perhaps the fulmars, in their general external appearance, are more gull-like than any of the others mentioned.

Tracing our Longipennes back into geological times, there can be no question but what we can see at least some of their ancestors in the genus of toothed birds of the cretaceous beds of Kansas—the genus *Ichthyornis*, already mentioned above; and, in the various geological horizons existing between those comparatively early times and the present epoch, many fossil skeletons of gulls and gull-like birds have occurred. Many of these are in the hands of science, both here and abroad. A few years ago the present writer described a large collection of fossil birds from the Equus beds of Oregon (late tertiary, U. S.), belonging to Professor Thomas Condon and our very distinguished paleontologist, the late Professor E. D. Cope, of Philadelphia. In that collection I found the fossil bones of several gulls and terns, which were identical with those of existing species of our present avifauna. Others were extinct, but nevertheless very closely resembled forms now in existence. In short, this material threw but little light upon the question of the line of longipennine ancestry.

There must have been a great many forms that became extinct between the times of the cretaceous and the tertiary, and many of these yet remain to be found.

The gull selected for illustration in the present connection is the species known as Ross's gull, or Ross's rosy gull, it having been likewise called the Wedge-tailed gull, from the fact that its tail is of the cuneate form. Beyond this latter peculiarity, and its lovely rose-tinted breast in the adult, it has most of the characters common to any of our smaller and typical gulls. During the breeding season it has a plumage somewhat different from that, as shown in the figure; the adult being white, beautifully shaded with rose, with a pearly-blue mantle, and a black collar about the neck. The bill is black, while the feet, eyelids, and gape are a bright red. It has a length of about fourteen inches. This is a circumpolar species, of the Arctic regions, a few stragglers only occasionally coming south to the most northern parts of the North Temperate Zone. At one time it was exceedingly rare in museums and collections, but about ten or more years ago a large number were taken at Point Barrow by one of the United States Government expeditions. I believe that its breeding stations still remain unknown, and we yet remain in ignorance of many of the habits of this, one of the most beautiful of all the existing gulls.

Red, white, black, pearly-blue, and rarely, rose, are the prevailing colors of this family of birds. The young may show various shades of brown or gray, or are dusky. Adults in the breeding season are, as a rule, white, with a mantle of pearly-blue. Some of the species have black heads, and often much black is seen at the wing-tips or the primary feathers of the same. Marked changes of plumage take place with age, and different seasons, though usually the sexes are always alike. Several years elapse before the mature plumage is attained, the color of the bill and feet changing at the same time. The latter are invariably webbed, and not illy fitted for ambulatorial purposes. Commonly the tail of a gull is even, rarely forked or wedge-shaped, and never has median projecting feathers as in many of the jaegers. All the bigger forms have powerfully hooked beaks, apt to seize the small fishes upon which they largely feed. Indeed, the Great black-backed gull is a very marine raptorial pirate, who will not only rob other gulls and their kind of their prey, but will make excursions inland and hunt for the young and eggs of other birds to devour them. As a group they are cosmopolitan, and in suitable locations on our coasts, and over our great lakes and rivers, they occur in vast numbers.

As a rule, gulls build their nests upon the ground, and lay from two to three eggs, and these vary much in appearance, but are commonly of a cream color, heavily and variously blotched with dark spots and markings. I have eaten the eggs of many of the species and always found them excellent. Many of these birds procure their food by plunging in the water for it; others skim over the surface and pick it up; some rob other birds of it; while some may gather shell-fish and other marine invertebrates on the beaches and flats at low water. They are all good flyers, and swim with great buoyancy, ease, and grace. Loud, harsh notes are given vent to by the big species, while the smaller forms have shriller voices, and the young ones have a querulous whine, which is peculiar to them.

According to a writer at hand, "Several circumstances conspire to render the study of these birds difficult. With some exceptions, they are almost identical in form; while in size they show an unbroken series, individual variability in size is high; northerly birds are usually appreciably larger than those of the same species hatched further south; the male exceeds the female a little (usually); very old birds are likely to be larger, with especially stouter bill, than young or middle-aged ones. There is, besides, a certain plasticity of organization, or ready susceptibility to modifying influences, so marked that the individuals hatched at a particular spot may be appreciably different in some slight points from others reared but a few miles away. Incredible as it may appear, species and even genera have been based upon such shadowy characters." Some of the most extensive and highly interesting accounts of our commoner species of gulls are given by Audubon in his great work upon American birds, but to be appreciated these must be read *in extenso*, and I would be guilty of an injustice to quote any one of them only in part.

Many of the terns are of small size, and the largest of them rarely equal in this respect the average-sized gulls. With but few exceptions, the tail in them is deeply forked, the wings long and pointed, and the bill slender and acutely sharp, having much the form of the head of a narrow lance. On land they do not walk as well as the gulls, as their feet are more posteriorly placed, while the webbing of the same is not as perfect as a rule.

Delicate and slender in general contour, the sexes are barely to be distinguished by external characters, while the plumages for season and age markedly vary.

Confining ourselves to the North American forms, it is to be observed that the pattern of their coloration is quite constant for the majority of them. White predominates, and this, in some species, may be rose-tinted upon the under parts. Most frequently the head is black-capped, and the back, or mantle, as it is here called, is of a delicate pearl-blue or clear gray. The primaries of the wings are black, or dark-colored. As exceptions we may note that Trudeau's tern has a white head with a black stripe upon either side (Fig. 50); and in others the black cap is interrupted by a white frontal crescent. In the genus *Hydrochelidon* the species are nearly entirely black, while the Noddy terns have the whole body of a fine fuliginous brown. The bill is variously colored, the chief shades being yellow, red, black, and orange, often two of the colors being combined. Structurally, they depart but slightly from the gulls, and this departure is very gradual as we pass from the more laro-sternine types to the distinctly tern-end of the series. In flight they are buoyant, while at other times they far exceed the gulls in dash and vigor. Especially is this last the case when they are feeding, for they have the habit of balancing themselves on wing over the water

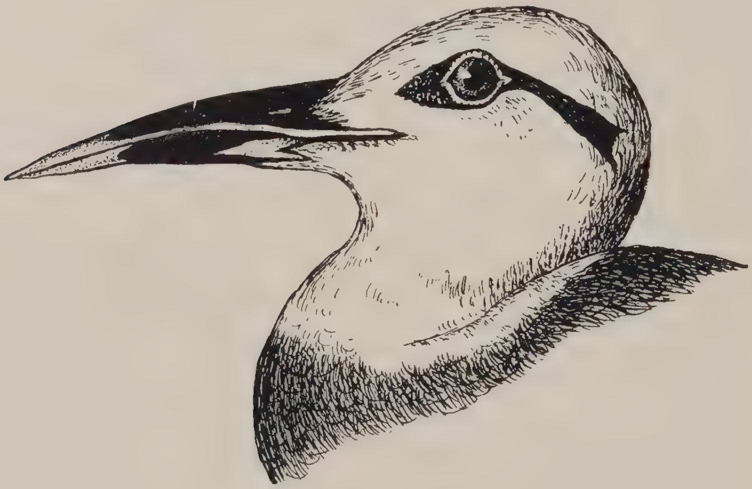

FIG. 50. TRUDEAU'S TERN.
Natural size. Drawn by the Author.

with bill pointed directly downward, when with a sudden dive they plunge into that element to capture the small fish upon which most the species largely subsist. Others, and usually the smaller forms of terns, skim, swallow fashion, over marshes and similar wet places, to gratify their more or less insectivorous tastes. Thus they have gained for themselves the almost world-wide name of sea-swallow, and it is quite suited to them. Terns are very indifferent swimmers, however, being far behind the gulls in this particular. A writer upon this subject says, "The eggs are laid in a slight depression in the ground, generally the shingle of beaches, or in a tussock of grass in a marsh, or in a rude nest of sticks in low bushes. They are one to three in number, variegated in color. Most of the species are maritime, and such is particularly the case with noddies, but nearly all are found inland. They are noisy birds, of shrill penetrating voice, and no less gregarious than gulls, often assembling in multitudes to breed, and generally moving in company. Species occur near water in almost every part of the world, and most of them are widely distributed. Of those occurring in North America, the majority are found in corresponding latitudes in the Old World. Some seventy species are currently reported. The true number is apparently just about that of the gulls (about fifty)."

The present writer has collected the Black tern in the marshes of Wisconsin, and as far in the interior as Wyoming. I have taken the Least tern frequently on Long Island Sound and the Potomac river, while the Noddy has often fallen to my gun on the coast of Florida and in the Bahamas, as has also the Sooty tern *(Sterna fuliginosa)*. There, too, I have collected the lovely Roseate tern, and numerous other species. But wherever we find them, or of whatever species, they cannot fail to command our attention and excite our interest, for among sea fowl, at least, they are to be reckoned with the loveliest forms of bird-life that cleave the air or fearlessly plunge into the waters to capture their finny prey.

We have in our United States avifauna four different and well-marked species of jaegers or skua gulls. These have been placed in two distinct genera, that of *Megalestris* and of *Stercorarius;* the first-named containing the Common skua *(M. skua)*, and the latter the Pomarine jaeger, the Parasitic jaeger, and the Long-tailed jaeger *(S. pomarinus, S. parasiticus*, and *S. longicaudus*, respectively).

The word skua is of Faeroese origin, and jaeger, or more properly jæger, is the German word for hunter, having reference, as we shall soon see, to the habits of the bird. Their technical names are equally well chosen, and we have but to remind the reader that *Stercorarius* is from the Latin and signifies "a scavenger," while *pomarinus* is derived from the Greek and refers to the large horny "cere" surmounting the external narial apertures of the superior mandibles in these birds—a character quite unique among marine forms. The presence of this structure there is interesting from another point of view, for the jaegers are distinctly rapacious in habit, as are the cered-beaked raptores among the terrestrial birds of prey. Skuas or jaegers have powerful beaks, as a rule, and strong feet, that are full webbed, with the claws all large and curved. Another peculiarity is seen in the tail, the main part of which is not especially long, being square, with the two central feathers more or less elongated. This character is particularly well developed in the Long-tailed jaeger, of which I present a drawing. There are some good mounted specimens of this species in the collections of the Smithsonian Institution, and upon examining them I find the plumage

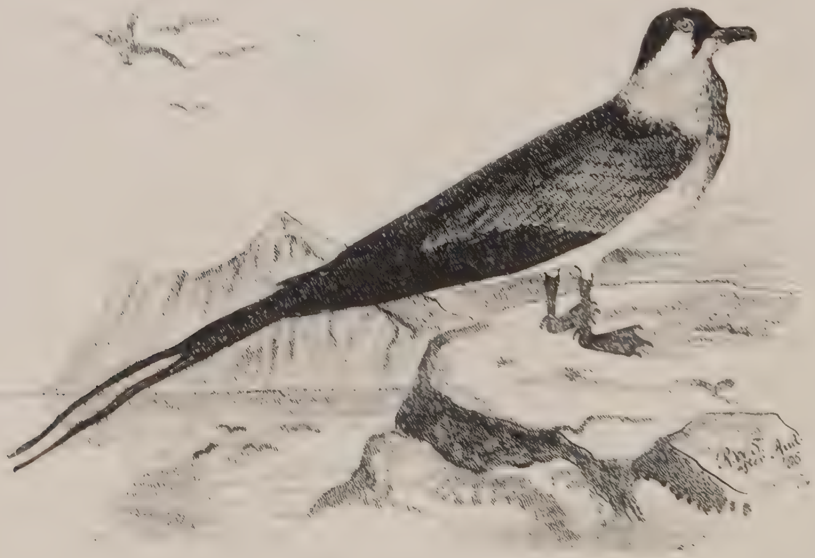

FIG. 51. THE LONG-TAILED JAEGER.

in the two sexes to be practically alike, but in the female the middle-tail feathers are not so long as they are in the male.

The parts below, as well as the neck, are white, the latter being shaded with light yellow. The head behind is sub-crested, the feathers being of a brownish-black color, which is also extended to include the area anterior to the cheeks and the top of the head. Above, this species is of a deep slate color, with the exception of the primaries and secondaries of the wings, the lateral tail feathers and the posterior halves of the central pair, all these parts being of a blackish-brown, more or less lustrous in tint. It is not uncommon, I learn, to meet with melanotic phases of plumage in the jaegers, to an extent to be considered almost a normal special condition. As a rule, these birds inhabit the sea coasts and great lakes of the arctic and sub-arctic regions, but there are exceptions to this, and the Long-tailed jaeger in winter occurs as far south as the Gulf of Mexico. With us, however, they all pass to the far northward to breed. Their habits of nidification are more or less like the gulls, and they lay from two to three dark-colored eggs, variously spotted.

In the matter of flight, the jaegers are pre-eminently powerful and rapid, and as they are the most relentless avian pirates that infest the high seas, they put their varied aerial accomplishments to no less base a purpose than persistently harassing all the smaller species of gulls and the terns, forcing them to either disgorge their food or robbing them of such as they may have in their beaks at the time of their making their attacks.

A great deal more might be said here about these voracious longipennine robbers, but we will pass now to a consideration of the remaining subfamily of the group of the terns. Of these we have many species, for which some four genera have been created, as mentioned above.

Unless others have been discovered within the past very few years, I am familiar with but three species of the birds we call skimmers, of the genus *Rynchops*. Two of them are found in Asia, and there is our own species, known as the Black skimmer or Razor-bill, which on the Atlantic coast ranges as far north as New Jersey, but has been occasionally taken in as high latitude as that of the Bay of Fundy.

Audubon has an excellent colored drawing of the Black skimmer *(R. niger)*, in his work, and this I have copied to illustrate this bird (Fig. 52).

A Skimmer has the proximal half of its bill a bright carmine red, the balance being black. But the curious form of this bird's beak is what commands the attention of every one who may study the species. "Among the singular bills of birds," says a writer, "that frequently excite our wonder, that of the skimmers is one of the most anomalous. The under mandible is much longer than the upper, compressed like a knife-blade; its end is obtuse; its sides come abruptly together, and are completely soldered; the upper edge is as sharp as the under, and fits a groove in the upper mandible; the jawbone, viewed apart, looks like a short-handled pitchfork. The upper mandible is also compressed, but less so, nor is it so obtuse at the end; its substance is nearly hollow, with light cancellated structure, such as is in a toucan; it is freely movable by means of an elastic hinge at the forehead."

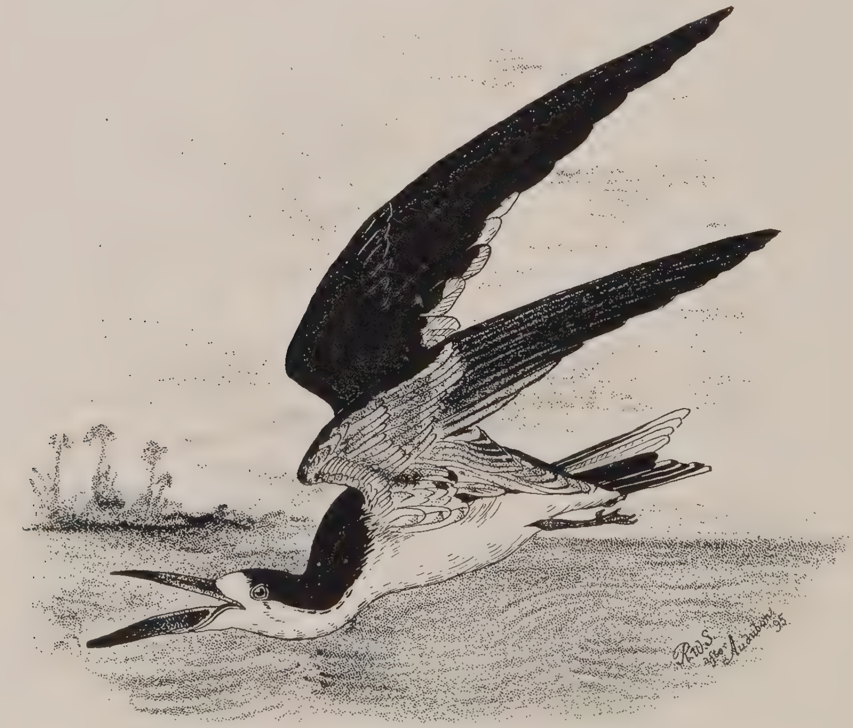
R.W.S. after Audubon. 95.

Fig. 52. The Black Skimmer.
About one-third the size of life.

Speaking in a general way, the Black skimmer may be said to have a plumage of black and white, while its feet in life are red. They range in length from sixteen to twenty inches, and the females are smaller than the males. During the breeding season the white of the under parts is tinted with a cream or rose color, calling to mind similar changes in some gulls. The young are duller in color, being of a light grayish-brown, though they are white below. The form of the bill is not so decided, and the upper and lower mandibles are of more equal length. Nestlings of this species are extremely interesting subjects for study. A great many years ago, or in 1865, I had abundant opportunity to observe the habits of skimmers on the coasts of Florida, as well as on the Bahama Islands and the West Indies. Along the shore line of western and southern Florida especially, I saw thousands of them in those days. They lit in extensive "flocks" on the sand bars, or in loose, scattering parties skimmed over the surface of the water, often sallying up the large rivers for some little distance or extending their flights to include the great bayous that were not too far removed from the coast. They feed principally at night or evening time, or upon cloudy days. According to Audubon, who has left us an excellent account of *Rynchops*, "they spend the whole night on the wing, searching diligently for food. Of this I had ample and satisfactory proof when ascending the St. John river, in east Florida, in the United States schooner *Spark*. The hoarse cries of the skimmers never ceased more than an hour, so that I could easily know whether they were passing upward or downward in the dark. Being aware of the observations being made on this species by M. Lesson, I paid all imaginable attention to them, always aided by an excellent glass, in order to find whether or not they fed on bivalve shellfish found in the shallows of sand bars and other places at low water, but not in one single instance did I see any such occurrence, and in regard to this matter I agree with Wilson in asserting that, while with us, these birds do not feed on shellfish. While watching the movements of the Black skimmer as it was searching for food, sometimes a full hour before it was dark, I have seen it pass its lower mandible at an angle of about forty-five degrees in the water, whilst its *movable* upper mandible was elevated a little above the surface. In this manner, with wings raised and extended, it plowed, as it were, the element in which its quarry lay to the extent of several yards at a time, rising and falling alternately, and that as frequently as it thought it necessary for securing its food when in sight of it; for I am certain that these birds never immerse their lower mandible until they have observed the object of their pursuit, for which reason their eyes are constantly directed downward, like those of terns and gannets."

The flight of the Skimmer is elegant in the extreme, being more interesting and superior to that of any of the terns. Their cries, however, when upon wing, are harsh and more or less discordant. A slight excavation in the sand is the sole apology for a nest that this bird ever attempts to make. In this it lays, about the first week in May, three eggs. These are pure white, heavily blotched with black and various shades of dark brown, and often patches of a light purple color.

One of the earliest, and at the same time one of the best accounts of the Black skimmer is given by Darwin in his famous work entitled *Journal of Researches into the Natural History and Geology of the Countries visited during the voyage of H. M. S. Beagle round the world, under the command of Captain Fitz-Roy, R. N.* It is found in the first volume (p. 174), and a figure of the head of the skimmer is given: one of the earliest drawings of the species known to me (1846).

CHAPTER XIV.

PELICANS AND THEIR RELATIVES.

(Steganopodes.)

WE have three forms of Pelicans *(Pelecanidæ)* in the avifauna of this country. These are the American White Pelican *(Pelecanus erythrorhynchus)*, the Brown Pelican *(P. fuscus)*, and the California brown pelican *(P. californicus)*. The White pelican has been found in the interior as high north as Latitude 61°, and ranges south into Central America. Plenty of them are found in suitable localities in the valley of the Mississippi, along the Gulf coast, on the coast of California, and southward. In the northeastern States they are now only found as rare stragglers. Brown pelicans are Atlantic coast birds, and occur plentifully in the Bahamas and the West Indies. They rarely come north of North Carolina, and they range southward along the Mexican and Central American coast lines. In a few instances they have been found in the interior (Illinois). I am not familiar with the California brown pelican, but it is a form said by its describers to be found on the Pacific coast from the latitude of San Francisco southward.

As the name indicates, the plumage of the American white pelican is principally white, but the primaries of the wings are black. Sometimes the tail feathers are tinged with rose, and the lengthened feathers of the back of the head and the breast are a fine straw yellow. Its bill and feet are also generally of this color. This bird is remarkable for the peculiar triangular horny excrescence which is developed on the upper side of the bill of the male during the breeding season, and which after that time falls off without leaving a trace of its ever having existed there. This species lays two or three eggs. The brown pelican, of which I give a figure, has a dark plumage that is considerably variegated. Most of the head is white, shaded with yellow on the crown; the former color bordered with dark chestnut, runs down the neck. The wings are mostly blackish and the tail is gray. Above, the body is dusky, becoming gray on the wing coverts, while below it is inclined to be more brown, with lateral white stripes. A mixture of yellow, blackish, and chestnut feathers are found on the forepart of the neck, low down towards the breast. It lays from two to three eggs, which are white, with chalky shells. As we all know, the principal character of these truly magnificent birds is the great skinny pouch attached to the entire borders of their very weak lower jaws. This pouch is best developed in the Brown Pelican, where it extends at least half way down the neck.

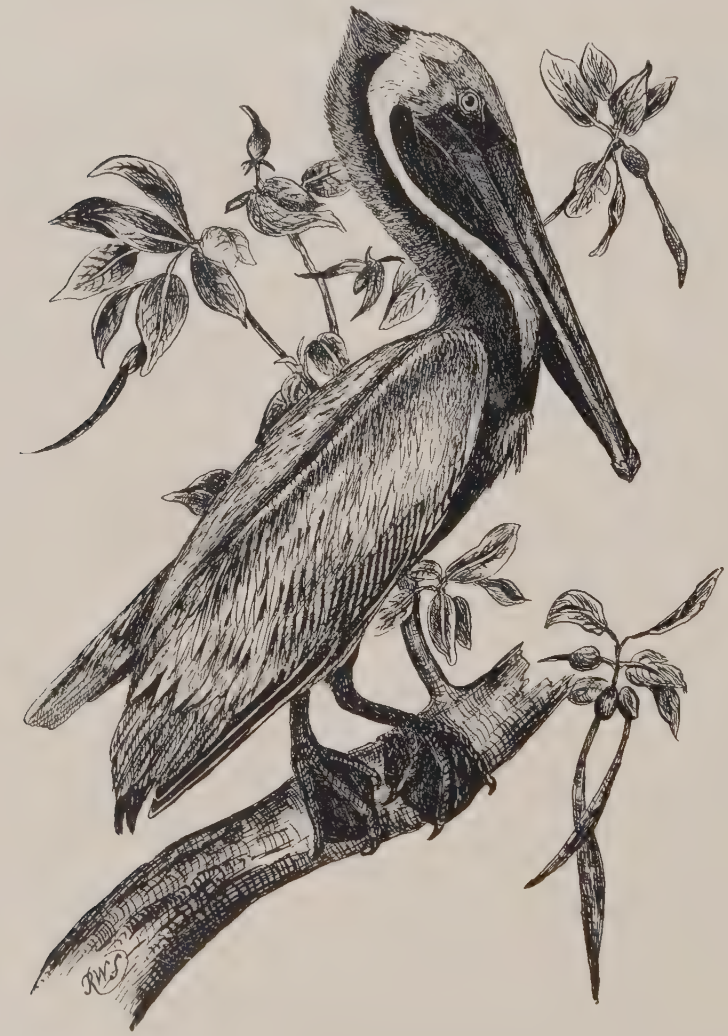

FIG. 53. THE BROWN PELICAN.
By the author, after Audubon, and greatly reduced.

Pelicans consume myriads of small fishes, rarely large ones, and they dip them up by means of the pouch just described. At one time I was among the Brown pelicans for months on the Bahama Cays, and it was very interesting to watch them fishing. They would plunge down from on wing sometimes, and at others dive while swimming on the water. By a muscular contrivance they can both contract their pouch or expand it by a lateral extension of the sides of the jaw to which it is attached. The little fishes are swallowed by the bird tossing its head backwards, contracting its pouch, and swallowing the prey. During this act the water taken up at the dive runs out at the angles of the mouth. In feeding their young they disgorge into their opened mouths a quantity of partially-digested fish from their crops, and do not, as is commonly supposed, carry living fishes to them in their pouches. Still less is it hardly necessary for me here to disprove the story that a pelican feeds its young with blood from its own breast—such a myth may answer for the decorative purposes of great stained-glass windows in churches, but surely the truth-loving natural historian of animals finds no use for the statement. Our space is too valuable here to enter into the question of the many ingenious suggestions which have been advanced to explain the origin of this mythical legend. We leave that to others. Pelicans are both excellent swimmers and divers. Flight is greatly enhanced by the air which thoroughly permeates their skeletons and other parts, while their large, completely webbed feet account fully for the possession of their swimming propensities. These birds are often kept alive in zoölogical gardens and private parks, and those who visited Chicago at the time of the World's Fair may remember the number of Brown pelicans that were kept on the waters of the beautiful and picturesque lagoons that formed such a distinctive feature of the magic White City, now a thing of the past.

It is quite a rare thing to see a White pelican perch in a tree, though less so to see a Brown one in such a situation. Neither species has any great fear of man, the White ones during flight often passing close to him, or to buildings in towns and cities during their migrations. After gorging themselves with food they will often doze for a long time on the water, or on some sand bar or similar place. Under these circumstances, if suddenly surprised, they may be taken alive, as they rise on the wing with difficulty, due not only to the state they are in, but also from the fact that they may have their pouches half filled with fish. They are great gluttons. In some of the Bahama isles I have observed as many as fifty Brown pelicans in one flock, with others on the water fishing. On the coasts of Cuba and Hayti and the Mosquito coast of Mexico, I have observed both species. In southeastern Europe and the adjacent countries of Asia and Africa they have a species of pelican *(P. onocrotalus)* much resembling our White pelican. Some ten or a dozen other kinds are found in various parts of the world. I have described the bones of a fossil pelican from Oregon, and similar remains have been found in England. *P. onocrotalus* was well known to the ancients, and was frequently figured on their monuments.

Some very interesting birds of the suborder *Steganopodes* are the relatives of our pelicans in the avifauna of this country. There are in the first place the two species of Tropic birds of the genus *Phaethon*; then there are six species of gannets *(Sula)*; the curious Snake bird, also known as the Darter or Anhinga *(Anhinga)*; at least eleven different kinds of cormorants *(Phalacrocorax)*; and finally the famous Man-o'-War bird *(Fregata aquila)*.

According to Newton, the Tropic birds have been so called by "sailors from early times, because, as Dampier *(Voy.* i, p. 53), among others, testifies, it is "never seen far without either Tropick," and hence, indulging a pretty fancy, Linnæus bestowed upon it the generic term, continued by modern writers, of *Phaeton*, in allusion to its attempt to follow the path of the sun. There are certainly three well-marked species of this genus, but their respective geographical ranges have not yet been definitely laid down. All of them can be easily known by their totipalmate condition, in which the four toes of each foot are united by a web, and by the great length of the two middle tail-quills, which project beyond the rest, so as to have gained for the birds the names of "Rabijunco," "Paille-en-queue," and "Pijlstaart," among mariners of different nations. These birds fly to a great distance from land and seem to be attracted by ships, frequently hovering round or even settling on a mast-head.

"The Yellow-billed Tropic-bird, *P. flavirostris* or *candidus*, appears to have habitually the most northerly, as well, perhaps, as the widest range, visiting Bermuda yearly to breed there, but also occurring numerously in the southern Atlantic, the Indian and a great part of the Pacific Ocean. In some islands of all these three it breeds, sometimes on trees, which the other species are not known to do. However, like the rest of its congeners, it lays but a single egg, and this is of a pinkish-white, mottled, spotted, and smeared with brownish-purple, often so closely as to conceal the ground-color. This is the smallest of the group, and hardly exceeds in size a large pigeon; but the spread of its wings and its long tail make it appear more bulky than it really is. Except some black markings on the face (common to all the species known), a large black patch partly covering the scapulars and wing-coverts, and the black shafts of its elongated rectrices, its general color is white, glossy as satin, and often tinged with roseate. Its yellow bill readily distinguishes it from its larger congener *P. aethereus*, but that has nearly all the upper surface of the body and wings closely barred with black, while the shafts of its elongated rectrices are white. This species has a range almost equally wide as the last; but it does not seem to occur in the western part of the Indian Ocean. The third and largest species, the Red-tailed Tropic-bird, *P. rubricanda* or *phœnicurus*, not only has a red bill, but the elongated and very attenuated rectrices are of a bright crimson-red, and when adult the whole body shows a deep roseate tinge. The young are beautifully barred above with black arrow-headed markings. This species has not been known to occur in the Atlantic, but is perhaps the most numerous in the Indian and Pacific Oceans, in which last great value used to be attached to its tail-feathers to be worked into ornaments." *(Dict. Birds;* Pt. IV, pp. 989-991.)

Of all our various species of Gannets, the one probably widest known is the common Gannet, or, as it is often called, the Solan Goose, the *Sula bassana* of science. This large water-fowl occurs upon the coasts of the north Atlantic, migrating to the southward as far south as the Gulf of Mexico in the winter time. Adult Gannets are as large as a small goose, having, however, the wings and the tail considerably longer. At three years of age they gain their full plumage, which is almost wholly white, the head and neck alone being shaded with a buffy color, while the large feathers of the wings are black. Around the eyes and on the throat the skin-tracts are bare and tinted a deep blue. Young birds of the first year are dark brown, spotted with white, and the nestlings, when first hatched, are nude and blind, but they soon gain a plumage of thick, white down, quite equal to that of the swan, and much sought after by the manufacturers of muffs and tippets. This Gannet builds a shallow nest of seaweed, placed upon the ground, and in it lays its single white egg, that is not unlike the egg of some of the Cormorants, having the same chalky covering overlaying the shell. Fishes that go in great shoals near the surface are followed by these birds, and through this circumstance fishermen often detect the presence of the former, at considerable distances. Gannets are but indifferent swimmers and divers, while, on the other hand, their " prey is almost invariably captured by plunging upon it from a height. and a company of Gannets fishing presents a curious and interesting spectacle. Flying in single file, each bird, when it comes over the shoal, closes its wings and dashes perpendicularly, and with a velocity that must be seen to be appreciated, into the waves, whence it emerges after a few seconds, and, shaking the water from its feathers, mounts in a wide curve, orderly taking its place in the rear of the string, to repeat its headlong plunge so soon as it again finds itself above its prey." (Newton.)

These birds are not used for food, but are simply captured for their feathers alone. This is sometimes effected by tying a herring on a shingle and towing it behind a row-boat. The Gannet plunges down upon the bait, and it either kills itself by the shock of the blow received, or else thrusts its beak clean through the floating shingle, and is thus easily taken by being drawn up to the boat by the tow-string. At many of their former places of resort the Gannets are rapidly decreasing in numbers, where formerly they were present in immense legions. While in Florida and on the Bahama Banks, I frequently collected specimens of the blue-faced gannet, or "Booby," as it is otherwise known *(Sula cyanops)*, and have also had in my possession living specimens of the Blue-footed booby and Brewster's booby *(S. gossi* and *S. brewsteri)*. They were taken for me on the coasts of Lower California, and gave me the opportunity of thoroughly working out their osteology.

Even a more interesting form than any of the gannets is the species of Snake bird we have in this country, occurring, as it does, in the inland waters of the southern States, especially those of Florida. Specimens, however, have been taken as far north as the Carolinas, the mouth of the Ohio River, and southern Kansas.

Approaching in some respects some of the smaller species of cormorants, this bird is nevertheless easily distinguished from them, in so far as external appearances go, by its long and extremely slender neck and beak; its trimmer body, and more elongated tail. Either the male or female is a bird of beautiful plumage, particularly during the breeding season, as different as they are in this respect. A male at this time is largely clothed in black feathers, exhibiting a greenish gloss. Its eyes are bright crimson, while the naked skin around them is green, and of the throat, orange. A white stripe runs down either side of the neck, showing lilac reflections. White markings occur upon the long feathers of the shoulders and the lesser coverts of the wings. The wings and tail are black, the latter being tipped with reddish brown. In the female the head, neck, and pectorial region is of a buffy color, a reddish tinted band limiting the latter below. These birds have the habit of perching upon the outstanding and dead limbs of trees overhanging the pools of their habitat. From these points of observance they watch for their finny prey in the waters beneath, and by rapidly darting down upon it, plunging beneath the surface, secure the same with their dagger-like beaks. Upon coming into view again, nothing is seen save the snake-like upper parts of the Anhinga, stealthily making off with its capture. Hence the popular name of the species. Under water, its powers of swimming are simply unrivaled, being able to capture a fish, however agile the latter may be, and in these subaqueous excursions it exhibits the most remarkable maneuvers, spreading its tail and shooting about in a manner most extraordinary. None of the smaller fishes upon which it feeds can escape the attacks of this consummate fisherman. It exhibits even these qualities in captivity, "taking—apparently without effort—fish after fish," as Newton remarks, "that may be introduced into its tank, however rapidly they may swim and twist, and only returning to its perch when its voracious appetite is for the moment appeased or its supply of food temporarily exhausted."

These birds lay four eggs in a large, bulky nest, placed in a tree, and usually overhanging the water.

Cormorants of one species or another are found upon all the coasts of the United States, her offlying islands, and on the great lakes and largest rivers. In many of these places they are likewise known as Shags, which by many people they are popularly called. They, as in the case of Anhinga, are also most voracious fishermen, and are, too, extremely expert swimmers beneath the surface of the water. In former times fishing with cormorants was a favorite pastime in England, and in China is still followed in a manner that it there has been, in that country, for many generations. The birds are kept in confinement or are so far domesticated as not to require restraint of any kind. They are seen perched upon the prows of the river-boats, and when in use their masters buckle a ring around the neck of the bird in order to prevent deglutition, then the fishes it captures are taken away from it upon its coming up to the boat. The signal for the bird to commence is announced by the boatman striking the water with his oar. Fish after fish is taken until the master is satisfied, whereupon the cervical ring is removed and the birds are allowed to satisfy their own demands. In nature they frequently gorge themselves to the very verge of gluttonous inebriety; then repairing to the crags of rarely frequented rocks and cliffs, dose away, safe from the disturbance of their enemies, until digestion over, they once more seek the fishing-grounds.

Thirty or forty species of cormorants are found in various parts of the world, but although varying not a little in size, plumage, and to a lesser degree in structure, their habits are much the same wherever we find them in nature. Many excellent accounts have been published in regard to them, and considerable attention been given to their anatomy.

The Men-o'-War birds I have seen upon a great many occasions in the harbors of Havana, Matanzas, and Cardenas, upon the north coast of Cuba, as well as at points around the entire coast line of the Gulf of Mexico. In the matter of oceanic, open-air flight they are hardly without a rival. On the ground they are as clumsy as a Kingfisher, and for much the same reason, as their feet and legs are aborted to an extraordinary degree. In body, too, speaking comparatively, they are likewise small, but their immense expanse of wing and long, forked tails give them peculiar powers of buoyancy in the air. From tip to tip of wing they have an expanse equal to that of a swan, but with a trunk no bigger than that of a large jaeger. Often I have seen them sailing, like so many turkey buzzards, high above the surface of the ocean, and this usually after feeding. When the latter time arrives, however, their habits are entirely different, for it is then that the Frigate-birds display their very tyrannical dispositions, and as in the case of the White-headed eagle, they are the robbers of all the boobies and gulls in the neighborhood, as is the former the despoiler of the Osprey. They breed in communities, as a rule, upon high trees near the water. In their big, shiftlessly constructed nests each bird deposits her single white egg, it having a chalky shell, not at all unlike that of a cormorant's. Nestling birds have a plumage of dense white down, as in the case of vultures *(Cathartes)*, and the feathers of the adult come out through this coat as the individual matures. Adult males are blackish brown above, having a metallic sheen to it; the females showing white beneath, with feet of pink. But the males have black feet and a scarlet gular pouch, the last being easily observable while the birds are upon the wing.

CHAPTER XV.

MEADOW-LARKS AND PARTRIDGES.

(Genus *Sturnella: Perdicinæ.)*

WE have in this country, as elsewhere, quite an extensive list of birds that, although they are not considered by true sportsmen to be typical game birds, yet they are very generally shot by gunners not only for table use, but for sale in the game markets where they are frequently displayed. Some of these are esteemed by many to be very excellent eating, and the truth of the matter is, it is not easy to draw a hard and fast line between what a stickler among sportsmen and an all-round gunner would call game.

In my time I have met with people who were very fond of nighthawks *(Chordeiles)*, and would spend a whole evening in shooting a sufficient number of these caprimulgine birds for their table; while upon the other hand, most surely wild pigeons, turtle doves, the smaller plovers, and sandpipers come far nearer to being true game. It is in this latter list that the Meadow-lark belongs, rather than with other pseudo-game birds, as robins, flickers, blackbirds, and coots.

In the present chapter it is my intention to write of the natural history of the meadow-larks, and while upon this subject of game birds it may be said that they offer not a few characters and habits that almost entitle them to a place upon the list with them. First of all, if the birds be not too old, they are by no means an indifferent fowl upon the table, and in truth two-third grown ones are excellent eating, having the qualities of sufficient size and tender flesh. During the autumn months, and in those fields where the meadow-grass is not too meager and short, these birds will occasionally stand for a dog, but they cannot invariably be relied upon for this, and will most often run through the verdure ahead of the animal, to arise at will further off. When once in the air, however, and within range, they offer tempting shots and not always easy targets. Sometimes in flight they are quite erratic enough to suit the tastes of the most fastidious of sportsmen; often this flight is more than swift, while usually, as noted by Wilson, it is "in the manner of the Grouse and Partridge, laborious and steady, sailing, and renewing the rapid action of the wings alternately."

Meadow-larks, too, sometimes congregate in large, loose flocks, so the sport of hunting them, where they are plenty, does not flag, and a good bag can be made in a few hours. Then the coloration of the upper parts of the bird is decidedly gamy, although the rich yellow of the under parts rather inclines the orthodox sportsman to look at it askant, and with an expression of contempt often pronounce it to be nothing more than a passerine bird, belonging to the group of song birds known as the oscines, and most likely related to the orioles, starlings, and blackbirds, all of which is true enough, to be sure.

Notwithstanding this, young America will nevertheless, as heretofore, still continue to hunt the Old Field Lark, as it is termed in so many sections of the country, and in doing so, gain the first necessary lessons of shooting on the fly. For one, I know my experience with them as far back as 1863, in the salt marshes of Long Island Sound, taught me the tricks of the art, and it was through that practice that I sooner gained the necessary control of eye and hand that permitted me to drop in succession ten woodcock in the cover, and that, too, when the birds were stimulated with the crisp air of an October morning, and flew as though they had been shot out of a catapult.

The plumage and appearance of our Meadow-lark is so well known to all of those who are familiar with our common birds, that a detailed description would obviously be superfluous, especially as such a description would probably not be read or used by those who take no interest in matters of this kind, a charge that I am quite sure cannot be brought to the door of any reader of the present work. For many years the bird has been known to science as *Sturnella magna*, the first or generic name being the Latin diminutive of the word *sturnus*, a starling, and the second, or specific name, likewise from the Latin, being derived from *magnus*, large or great; a most incongruous combination, indicating as it does a little big starling. There are two sub-species in the genus—namely, the Mexican meadow-lark *(S. m. mexicana)*, and the Western meadow-lark *(S. m. neglecta)*, the first named being found from the lower Rio Grande valley to Panama, and the second in western United States southward through certain parts of Mexico.

In southern America there is also another representative of this genus, small in size, generally darker above, but what is most striking, it has a red breast and throat instead of a brilliant yellow, as in *S. magna*. Mr. Ridgway, who is probably the best authority we have upon birds among us, says that the Mexican Meadow-lark is smaller than our eastern form, with "smaller bill, but larger feet." The Western meadow-lark is even more conspicuously distinguished, being paler and grayer above, with the black markings not nearly so pronounced. This latter bird I have shot in a great many western localities, and have noticed especially the marked difference in its note as compared with our eastern form *(S. magna)*. Some of the individuals I shot in New Mexico were markedly pale above and light beneath, and as to a female of this sub-species, one could never confound it with our bird here in the Atlantic States. In some portions of the Mississippi valley the ranges of the two forms often widely overlap, and in consequence hybrids are occasionally to be found; but these facts only likewise tend to prove the distinctness of *S. magna* and *S. m. neglecta*, the latter having gained its sub-specific name for having been so long overlooked by ornithologists.

Our eastern Meadow-lark can be considered to be but partially migratory, and I have found not a few of them in the winter time in Central New York, and Wilson remarks, "It is probable that, in the more rigorous regions of the north they may be birds of passage, as they are partially so here; though I have seen them among the meadows of New Jersey and those that border the rivers Delaware and Schuylkill, in all seasons, even when the ground was deeply covered with snow." Wilson, by the way, also adds that in his day throughout the season these birds were exposed for sale in the Philadelphia markets, being considered for the table but little inferior to quail.

When Meadow-larks do not alight upon the ground they most frequently select the very top of some tree or shrub or end of projecting fence rail in a fence, and the like, and from such points as these it is that he pours forth his prolonged notes, so famous for their clarity, tenderness, and sweet tone. They also, at times, give vent to a rattling clatter of note so different from the other, that one would hardly believe it was uttered by the same bird. It is said that the female does this more often than the male bird.

Among the rice fields of the south, during the winter, these birds are sometimes very abundant, coming often close to the

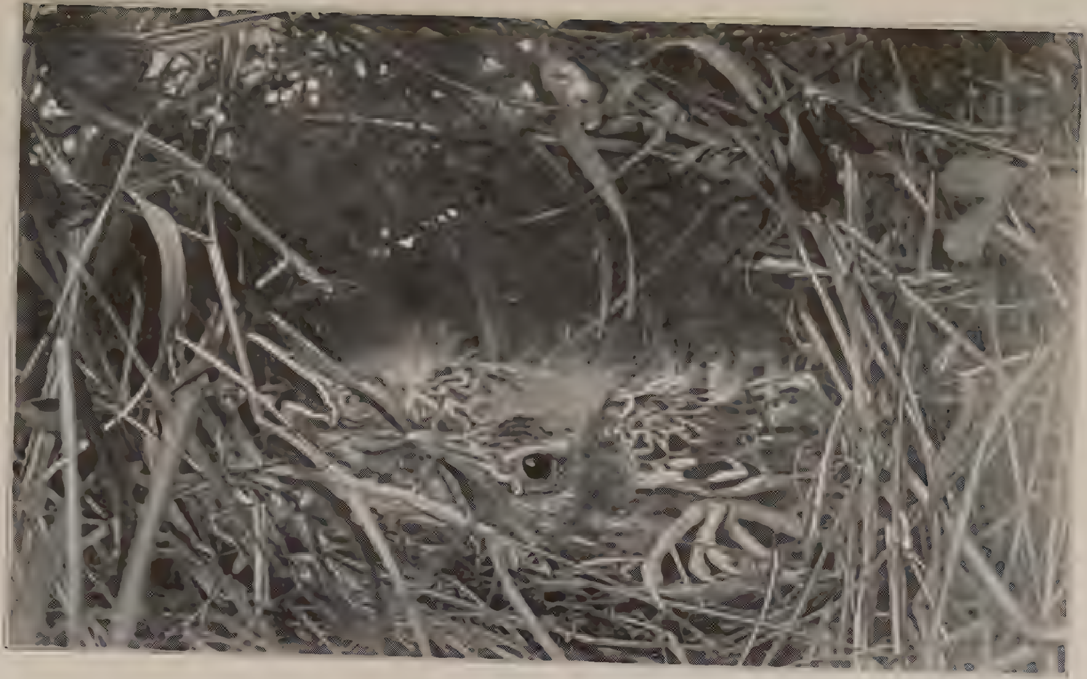

FIG. 54. NEST OF MEADOW-LARK CONTAINING TWO YOUNG (*Sturnella magna*).

Reproduced from a photograph taken by the author. Slightly reduced from life-size.

dwelling houses and outbuildings upon the plantation, exhibiting but little fear of man; while in the north during the same season I have many times noticed three or four of them in the middle of a country road where the snow has disappeared and left a small patch of ground bare. Here they would be engaged in picking the grain from the droppings of horses that had passed, and were often in company with Juncos and Snow buntings. Practically it may be said that the Meadow-lark rarely or never does any serious injury to our grain fields, as he is more partial during all the warmer parts of the year to a varied list of insects upon which he feeds, as well as the seeds of certain grasses and other plants.

Just at this writing I do not happen to remember of ever having seen a Meadow-lark very far within the boundary line of heavy timber, although one may occasionally be met with in a limited open space more or less closely surrounded with trees. Into such places they alight sometimes in order to capture or feed upon the insects that have perchance congregated there.

When mating time arrives, as spring comes round, the old male birds of this species exhibit a very considerable amount of excitement, and the study of their quaint courtship is replete with interest. Two males will sometimes chase a female, only apparently reluctant, all about some old pasture field, singing to her at the top of their voices; while in flight their wings, by the tremulousness of their motion, indicate the passion so keenly felt by their owners.

Should the semi-blind trio become exhausted by these efforts, all may come to alight upon some convenient fence-rail, where, with a fervent consort upon either side of her, the coveted female is treated to a united shower of notes, accompanied by a wing-flipping and a tail-spreading, such as no hen in all the genus could resist, whereupon she is obliged to make her choice quickly, and with her chosen one flies away.

Meadow-larks build their nests upon the ground, usually somewhat below the surface, where it is overgrown by some tussock of grass, a bramble-briar, or other like protection. This chosen and natural excavation is lined neatly with fine grasses, the same also being used to form a partial overarching dome, the latter being helped out by the growing grass or leaves above the spot. From four to seven eggs are laid during the early part of June, the young hatching out in about fifteen days thereafter.

South of Maryland they probably breed earlier, about the middle of May, and in those regions two broods may be the rule. Both sexes take part in incubation, the female being the closest sitter, however, while the male is easily alarmed, thus frequently betraying the location of the nest. Major Bendire says the "eggs of the Meadow-lark vary considerably both in shape and size; the majority are ovate, while others are short elliptical, and elongate ovate. The shell is strong, closely granulated, and moderately glossy. The ground color is usually pure white; this is occasionally covered with a pale pinkish suffusion, and is very rarely pale greenish white. The eggs are more or less profusely spotted, blotched, and speckled over the entire surface with different shades of brown, ferruginous, pale heliotrope, purple, and lavender; these markings generally predominate about the larger end of the egg, and are rarely heavy enough to hide the ground color.

"In some sets the markings consist mainly of a profusion of fine dots; in others the spots are well rounded and fewer in number; and again they occur in the shape of irregular and coarse blotches, mixed with finer specks and dots; in fact, there is an endless variation in the style of markings."

The material described by Major Bendire has been examined by the present writer at the United States National Museum, and it is remarkable to observe the great variety of patterns of the eggs of this species. The same remark applies to the eggs of the western Meadow-lark, they averaging but slightly smaller than those of the eastern bird.

On the 18th of June, 1897, my little daughter, Sarah A. Shufeldt, discovered within a short distance of my home at Takoma, D. C., a nest of the Meadow-lark that contained but two young, and these would have been ready to shift for themselves in a few days. My son dug up the entire sod that supported this nest, bringing the whole, young and all, to my study, in as perfect a condition as possible, and not in the least disturbed. By me it was taken out of doors, and everything being favorable, I succeeded in obtaining a good photographic picture of a typical nest of this well-known species, and a copy of this is here reproduced in order to show how the young Meadow-larks appear within it.

The original of this picture was taken exactly natural size, and was only reduced in the reproduction.

Either one of these nestlings has the coloration of the upper

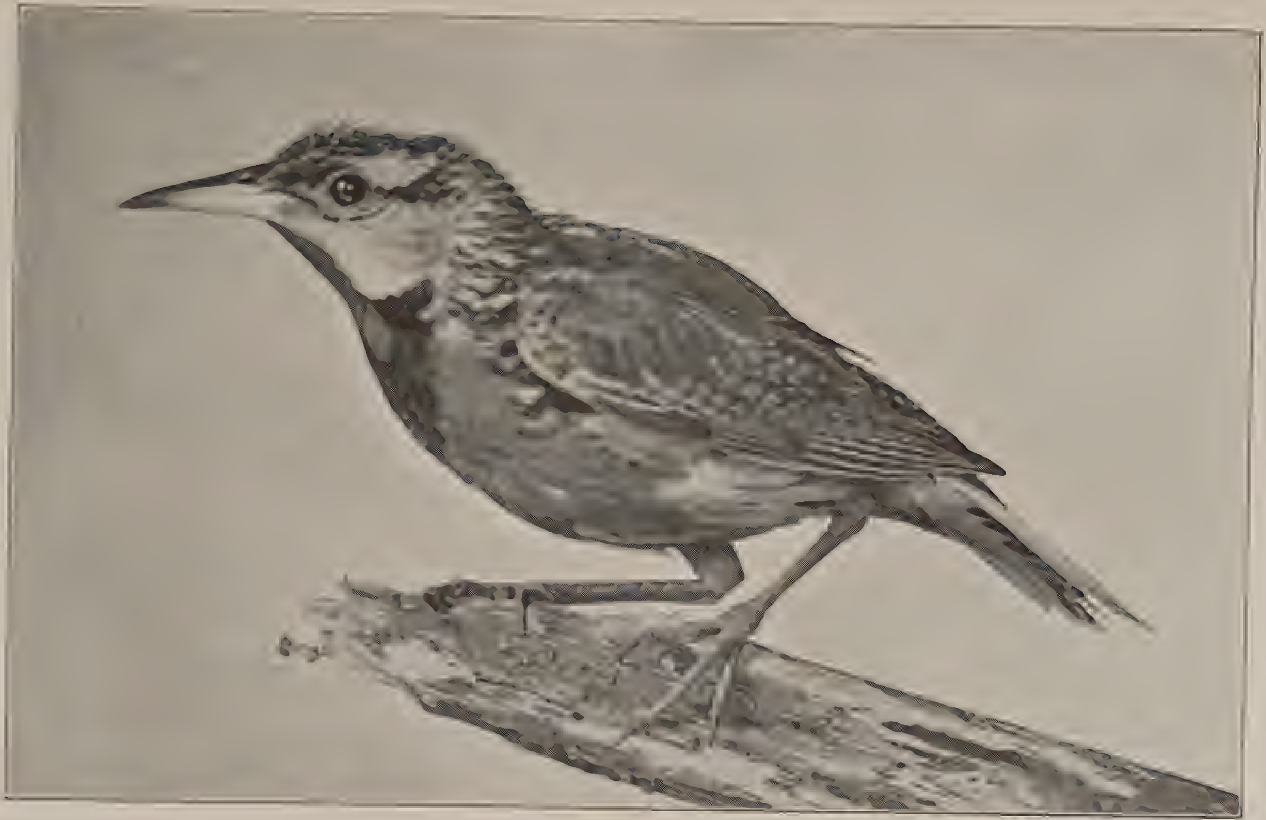

FIG. 55. THE MEADOW-LARK (*Sturnella magna*).

Adult. Photographed from life by the Author.

parts a good deal as we find it to be in the adult, but the lower parts are of a dull, brownish yellow, while the pectoral crescent is simply indicated by brown dashes upon the central part of each feather, the margins having the color of the breast below. Tufts of down occur in several places upon the head (behind the eyes) and in the wings; but what constitutes the most striking feature in one of these speciments is the great length of the legs and the very big feet. Young Meadow-larks leave the nest before they are able to fly, but so cute are they about hiding close that it is very rare to find one at this time; the coloration of the back likewise being greatly in their favor. The pair I refer to above were very clumsy and awkward, but nevertheless could squat and hide with all the skill of a young kildeer.

Since obtaining the above referred-to picture, my son has captured alive an adult male Meadow-lark, and I succeeded also in making a photograph of this specimen, one of the most difficult pieces of photography in which I was ever successful. The result is shown in Figure 55.

Sometimes the Cowbird lays its egg in the nest of this species, and Bendire cites a case where a second nest was built over the one containing the parasitic egg. Besides being shot by man, destroyed by numerous kinds of vermin, as weasels and the like, and by hawks; many Meadow-larks are never hatched out in those places where mowing machines are in constant use. Thus it is that in such regions the bird is becoming annually more rare, and this is unfortunate, in so far as man is concerned, for *Sturnella* is the best bird friend that the farmer has, and kills thousands of noxious insects every season.

Some of the habits of the other species and sub-species of the birds of this genius are extremely interesting, but the limitations of space forbid my touching upon these in the present chapter. The Meadow-lark is not found in the Old World, and, in fact, no bird that may be said to be very closely akin to it.

As has been said above, our Partridges belong to the group including the typical game-birds.

When I speak of the American partridges, I mean, in the present instance, the representatives of the sub-family *Perdicinæ* that legitimately belong to the avifauna of the United States. It will naturally include, however, all the partridges that occur north of the United States and Mexican boundary, on the North American continent; and these, as recognized in the second and last edition of the A. O. U. Check List of North American Birds, number seven species and six sub-species. Either in describing or arranging these birds, we usually commence with those partridges commonly known among us as the Bob-white. They constitute the genus *Colinus*, and lead off with our favorite eastern Bob-white, a bird which, broadly speaking, is called Quail in the north, and Partridge throughout the southern districts. Science knows the form simply as *Colinus virginianus*, and its geographical distribution has been given in the Check List as "eastern United States and southern Ontario, from southern Maine to the South Atlantic and Gulf States; west to central South Dakota, Nebraska, Kansas, Oklahoma, and eastern Texas. Of late years has gradually extended its range westward along lines of railroad and settlements; also introduced at various points in Colorado, New Mexico, Utah, Idaho, California, Oregon, and Washington. Breeds throughout its range." This partridge is replaced in Florida by the Florida Bob-white *(C. v. floridanus)*, and in "southern and western Texas, south to central Tamaulipas and southern Nuevo Leon, Mexico," and "western Mexico and Guadalajara," by the Texan Bob-white. The race of Bob-white that is restricted to the Floridan peninsula is both darker and smaller than the species of the north and east, while, according to Ridgway, in the Texan Bob-white the upper parts are somewhat of a rusty color (except anteriorly), "an olive-grayish tint prevailing, the scapulars, tertials, and lower back usually without conspicuous black blotches, and the general surface usually barred with lighter; black markings of lower parts usually broad and nearly transverse, as in *C. v. floridanus*. Adult male usually with a very distinct band of uniform pale cinnamon across chest, immediately beneath the black collar." From Sonora to southern Arizona, we met with the Masked Bob-white *(Colinus ridgwayi)*, which was first discovered by Mr. Herbert Brown, of Tucson, Arizona, and described by Mr. William Brewster. It is a beautiful species, and a very different looking bird as compared with our eastern Bob-white. There is an excellent account of its habits and range in Bendire's grand work on the "Life Histories of North American Birds," and, to the best of my recollection, it was figured in colors and published by Dr. Allen several years ago in the reports of the American Museum of Natural History. The genus *Colinus*, then, is made to contain two species and two subspecies of Partridges, commonly known as Bob-white; and we next pass to the genus *Oreortyx.* These are elegant Partridges of great beauty of plumage, there being one species of them and two subspecies, all confined to the western part of the United States. The type of the genus is the mountain Partridge *(O. pictus)*, which was described by Douglass in the Transactions of the Linnean Society in 1829. As far as now known, its present geographical distribution includes the "Pacific coast region, from San Francisco Bay north to Washington." It has also been introduced on Vancouver Island.

A paler race of these birds, distinguished as the Plumed Partridge *(O. pictus plumiferus)*, occurs upon both slopes of the Sierra Nevada Mountains, and eastward to the Panamint range, thence to Mount Magruder in Nevada; it is also found south in the coast ranges from San Francisco Bay to Lower California. (Campos.) They are wonderfully handsome birds, more so, I think, than the remaining subspecies of this genus; namely, the San Pedro Partridge *(O. p. confinus)*, which, although much like its plumed relative, has a somewhat thicker bill, and is grayer above. So far as at present known, it is a race confined to the San Pedro Mountains of Lower California, where it was discovered by A. W. Anthony, and described by him in 1889 in the Proceedings of the California Academy of Sciences.

Our largest genus of American Partridge is the genus *Callipepla,* containing as it does three species and two subspecies. The Scaled Partridge *(C. squamata)* is, according to the A. O. U. List, found upon the "tablelands of Mexico, from the valley of Mexico north to central and western Texas." It occurs also about Santa Fé, New Mexico, and in certain localities in southern Arizona. I have seen specimens in the flesh of this bird, shot fifty miles east of Fort Wingate, New Mexico. It is replaced in northeastern Mexico and the lower Rio Grande valley in Texas by the sub-species known as the Chestnut-bellied Scaled Partridge *(C. s. castanogastris).* A very different-appearing species is the California partridge *(C. californica)*, known along the coast region of California, where it occurs as the "Valley" or "Top-knot quail." It is found as far south as Monterey, and it has been successfully introduced into Oregon, Washington, and British Columbia. Bendire says, "Their favorite haunts are the undergrowth and thickets along water courses, brush-covered side hills, and canyons, frequenting the roads, cultivated fields, vineyards, and edges of clearings to feed. It is a constant resident, and breeds wherever found." A subspecies of this form is also called the valley partridge *(C. c. vallicola)*, but it is a gayer-colored bird, with a paler-tinted plumage and a different range. It inhabits the valleys of the mountains and foothills of the interior of the State of California, especially the Sierra Nevadas as far south as Cape St. Lucas, and eastward to the Panamint mountains. In western Texas, New Mexico, Arizona, and throughout the southern portions of California, Nevada, and Utah; in the valley of the Colorado, and thence southward into northwestern Mexico, we meet with Gambel's partridge *(C. gambelii)*, a deserved favorite and a very handsome species.

Finally, this list of very interesting game birds is completed by the Massena Partridge *(Cyrtonyx montezumæ)*, which is by far one of the very finest and handsomest species in the United States. Geographically, it is distributed over the tablelands of Mexico, from the city of Mexico north to western Texas, and is also found in Arizona and New Mexico. It is a strikingly colored species and peculiarly marked in plumage, as will be observed in my figure of it that illustrates the present chapter. In Arizona and New Mexico they call this Partridge the "Fool Quail," while in western Texas it is known as the Black-bellied Quail, or simply as the "Black." I have never shot this bird, but while in New Mexico a number of years ago I was presented with some specimens of it in the flesh that had been killed only a few days before by Colonel Bates, of the Thirteenth U. S. Infantry. At the time I thought them to be among the handsomest game birds I had ever had in my hands.

In reference to the nidification and habits of the Massena Partridge, Mr. G. W. Todd wrote Major Bendire to the following effect: "I first met with the Massena Partridge in Bandera County, Texas, in 1883, where they were very scarce, and I learned but little of its habits for a long time. They are very simple and unsuspicious, and apparently live so much in such barren and waste places that they do not see enough of man to make them afraid. On seeing a person they generally squat at once, or run a little way and hide. They will hardly fly until one is almost on them, but when they finally do fly they go much further than either the Texan Bob-white or the Scaled Partridge, and on alighting they run rapidly for a little distance and then squat again, generally flushing easier the second time. It is rare to see more than six together; two or three are more often met with.

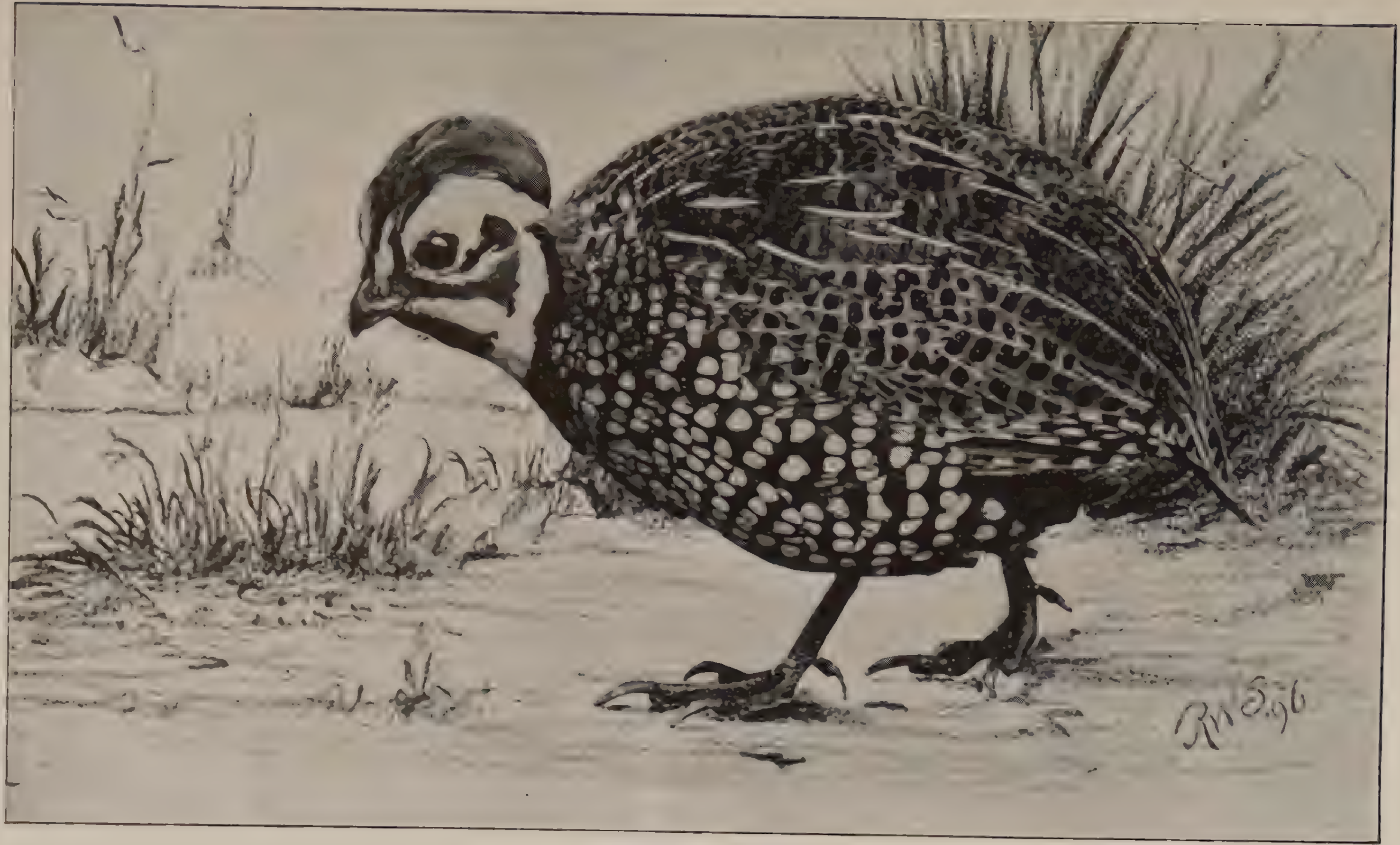

Fig. 56. The Massena Partridge.

Nearly life size.

In the fall of 1886 I found a covey of five on a wet and misty day, and killed three of them with a Winchester rifle before the remaining two flew. I never found their nest nor met with small young until this year. I saw but a single young bird this season, and this seemed to be entirely alone. They are not very abundant here, and are always found in the most barren places, among rocks and wastes, where even the prickly pear is stunted, and no bush grows over three feet high. When scared they utter a kind of whistling sound, a curious combination between a chuckle and a whistle, and while flying they make a noise a good deal like a Prairie Hen, though softer, and less loud, like 'chuc-chuc-chuc' rapidly repeated." "The only nest of this species I have ever seen was situated under the edge of a big bunch of a coarse species of grass, known as 'hickory grass.' This grass grows out from the center and hangs over on all sides until the blades touch the ground. It is a round, hard-stemmed grass, and only grows on the most sterile soil. According to my observations the Massena Partridge is seldom seen in other localities than where this grass grows. I was riding at a walk up the slope of a barren hill when my horse almost stepped on a nest, touching just the rim of it. The bird gave a startled flutter, alighting again within three feet of the nest and not over six feet from me; thence she walked away with her crest slightly erected, uttering a low chuckling whistle until lost to view behind a Spanish bayonet plant (yucca), about thirty feet off. I was riding a rather unruly horse, and had to return about thirty yards to tie him to a yucca before I could examine the nest. This was placed in a slight depression, possibly dug out by some animal, the top of the nest being on a level with the earth around it. It was well lined with fine stalks of wire-grass almost exclusively, the cavity being about five inches in diameter and two inches deep. At the back, next to the grass, it was slightly arched over, and the overhanging blades of grass hid it entirely from sight. The nest was more carefully made than the average Bob-white's nest, and very nicely concealed." Major Bendire, in describing these eggs, has said that they were "ten in number, were fresh when found, pure white in color, rather glossy, and the majority of them are more elongated than those of the Bob-white. A few of these eggs resemble those of the latter somewhat in shape, but the greater number are distinctly ovate and much more glossy. Some are slightly granulated, and corrugations converge from near the middle to the small end." (*Life Histories of North American Birds*, pp. 39, 40.) These were the first fully identified eggs of the Massena Partridge that had ever fallen into the hands of science, and it is interesting to know that they were not discovered until the year 1890. We have nowhere in the English language better and fuller accounts of the life-histories of our North American Partridges than are to be found in Bendire's great work from which I have just quoted, and it is greatly to be regretted that so useful and accurate an ornithological treatise should have, in being a government publication, received, at least at the outstart, such a limited circulation. It offers a great temptation to me to quote more extensively from its pages, but were I to do so I would soon exceed the scope of the present volume and the proper limits of this chapter.

In many other parts of the world we meet with numerous kinds of partridges, belonging to various genera not represented in this country. *Perdix cinerea*—the Gray Partridge—is *the* game bird of Great Britain. Subspecies of it are found in Siberia and Tibet. Europe also has the Red-legged partridge *(Caccabis rufa)*, and another of the same genus, while fine forms of the subfamily also occur in Africa and elsewhere.

CHAPTER XVI.

AMERICAN VULTURES.

(Superfamily Cathartoidea.)

(Family Cathartidæ.)

VULTURES of one species or another occur in nearly all parts of the world, but our forms of American Vultures constitute a family quite distinct from the falconine types of them found in the Old World and elsewhere. This difference has no especial reference to the habits of the birds in the two groups, but is seen in the anatomical structure of their representatives, and in this particular the distinction is a very radical one. Upon various occasions during the past twenty years I have published a number of accounts of the Vultures of this country, including one or two more or less elaborate memoirs upon their structure, illustrated by numerous plates. Several years ago, while living in New Mexico, I had a Turkey Vulture alive for a number of weeks, and at different times endeavored to secure satisfactory photographs of him, but owing to my inexperience in the art in those days, my success in the matter was not nearly as good as it has been recently. During the summer of 1896 my son slightly wounded a fine male specimen of our common Turkey Buzzard, and I kept him alive for nearly a fortnight. After he had practically recovered from his wounds, he was made the subject for my camera upon one or two occasions, and at the second attempt I succeeded in obtaining a life-size picture of his head, that for the exhibition of characters and general appearance was quite satisfactory. He proved to be not the easiest subject in the world, and those who have ever tried this experiment can appreciate the pride I feel upon presenting the fine reproduction of my attempt shown in the accompanying figure.

Passing by, as we must in as brief a chapter as the present one, any description of that biggest of all the world's vultures, the Condor of South America, and such other species as are strictly confined to that country and to Central America and Mexico, I shall confine my observations here to those forms only that are known to regularly occur north of the southern boundary of the United States.

Some have claimed to have seen Burrough's Turkey Vulture (*Cathartes burrorianus*) within our boundaries, but it is a matter of considerable doubt; while that the King Vulture (*Gypagus papa*) has been seen in Arizona is far less likely, as the striking black and white plumage of that large bird could hardly have

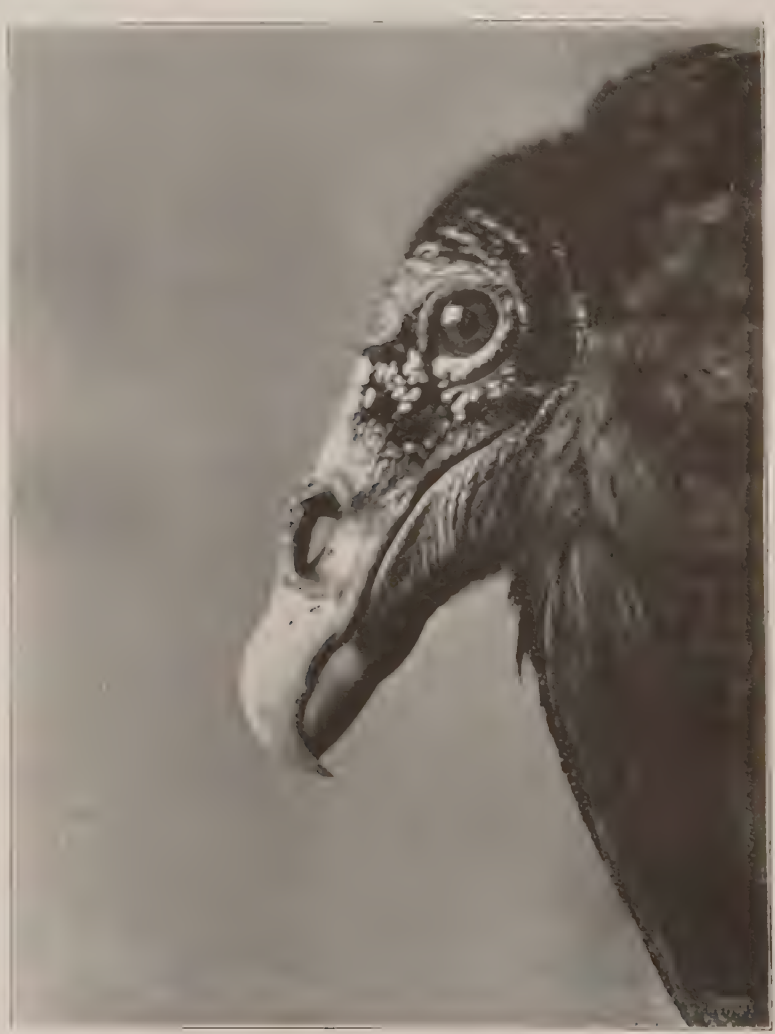

FIG. 57. HEAD OF THE TURKEY VULTURE (*Cathartes aura*) ♂: Adult.

Left lateral aspect: nat. size. From a photograph taken from life by the Author.

been mistaken for any other species, and it is more than probable that the single alleged occurrence in its case is based upon an entirely erroneous statement. Not taking into account, then, these and others alluded to, we find that the group is represented in our United States avifauna by three very remarkable species. These are the California Vulture *(Pseudogryphus californianus)*, the Turkey Vulture *(Cathartes aura)* (see figure), and the Black Vulture *(Catharista atrata)*. If we accept the geographical distribution of these several species as given in the Check List of the American Ornithologists' Union, we find that the California Vulture is confined to the " coast ranges of southern California, from Monterey Bay southward into Lower California, formerly north to Frazer River"; that the Turkey Vulture is found in "temperate North America, from New Jersey, Ohio valley, Saskatchewan region, and British Columbia, southward to Patagonia and the Falkland islands; casual in New England "; and finally, the Black Vulture occurs in the " South Atlantic and Gulf States, north regularly to North Carolina and the lower Ohio valley, west to the Great Plains, and south through Mexico and Central America, the West Indies, and most of South America, straggling north to New York, New England, and South Dakota; breeds in the United States from North Carolina coastwise to Texas, and in the interior to Indiana, Illinois, and Kansas."

In these vultures we find at the base of the middle and inner toes a distinct web to exist, and their weak feet are entirely unfit for grasping, being totally different in this particular from the talons of a falcon. Excepting the young, their heads are practically unfeathered, the openings to the nostrils being placed longitudinally. Their beaks are hooked, and their gape wide. In the main, as a rule, their plumage is of a dull black, but in the Turkey Vulture this is glossed with a greenish or violet shade, and the upper plumage shows a deep emargination of brown to the feathers. Old Turkey Buzzards exhibit transverse wrinkles on the top of the head and below the gape, while the distal or horny part of the beak is pure white, and the skinny parts about the nostrils and eyes are of a livid red color. Numerous small, white caruncles occur here beyond the eyes, while in the subadult individuals all these parts are blackish. They make their nests, as a rule, in cavities, either upon or near the ground; frequently in hollow logs or stumps. The Black and Turkey Vultures lay large and beautifully marked eggs, while on the other hand the eggs of the California Vulture are of a dull white with a greenish shade. From one cause or another, this latter bird is now nearly extinct, and personally I have never enjoyed the opportunity of studying its habits in its native haunts. Among oölogists its eggs are in great demand, and easily command $100 apiece, and good skins of this species will doubtless fetch an equal price.

Best known, perhaps, of all the characteristics of these peculiar birds is their habit of feeding upon carcasses, and as this fact is universally known, man, in the countries where vultures occur, regards them with great favor as useful scavengers. These habits have given rise to two very interesting problems in regard to them; one is the explanation for the soaring flight of vultures, and the exact manner of its accomplishment: and the other is the solution of the problem as to how they detect the presence of their food. Neither of these questions has been decided to the satisfaction of all minds. There is a large literature extant upon the first problem, and many interesting contributions to the second, which perhaps comes the nearer being understood. So far as my personal observation goes, I am satisfied that the carcass of a dead animal is made known to vultures almost entirely through the sense of sight, and not through the sense of smell. They are as far-sighted and as keen-eyed as hawks, while my anatomical studies of their olfactory apparatus revealed nothing indicative of unusual development. By this I by no means intend to convey the idea that they are at all lacking in the sense of smell, for if the air be tainted by the odor from carrion, and the wind in the right direction, they can detect the presence of the putrefying flesh for a very long distance, as I have personally observed, and that, too, when the carcass is completely concealed from view.

Young turkey vultures are largely covered with white down, which gives them a very remarkable appearance: added to this, they stand in a peculiar attitude, with the wings partly spread, and the head and neck curved forward, so as to place the former almost between the legs in front.

During the early part of the summer of 1897 a nestling of this species *(Cathartes aura)* came alive into the hands of Mr. William Palmer, chief taxidermist of the United States National Museum. This specimen he kindly loaned me, and I succeeded in making a very good photograph of it. The reproduction of this

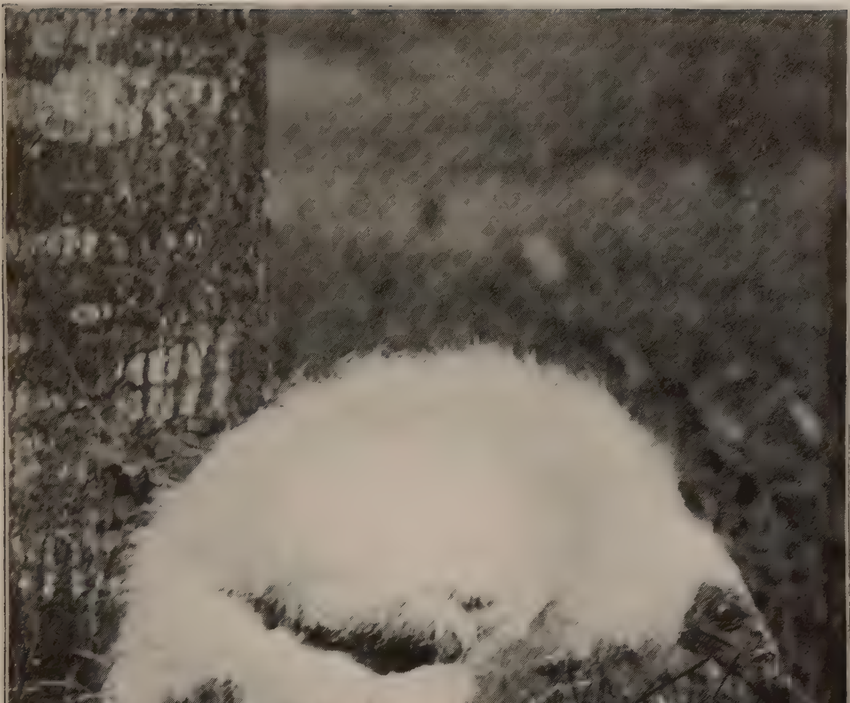

FIG. 58. YOUNG TURKEY VULTURE (*Cathartes aura*).

Greatly reduced. Reproduced from a photograph made from life by the Author

is shown in Fig. 58 of the present chapter, and it will be seen that it is only in the wings (primaries and secondaries) that black feathers appear at this age, while the face of the bird is naked to a distance a little back of the eye upon either side. Such parts of the posterior limbs and feet as are not covered with down are of a rather light soiled gray color, and always more or less whitened by the excrement passed by the bird itself. This bird fed ravenously upon carrion and raw meat of any kind, gorging himself at every meal; it likewise took water freely. When disturbed or handled it gave vent to a peculiar complaining cry, not easily described. It showed no fear of man at all, and is now, at this writing, still in possession of Mr. Palmer, who keeps it in his shops at the Museum (September 6, 1897), where it has become thoroughly domesticated. All its beautiful black plumage is out, and only a little of the white down left, and that is upon the upper part of the neck. Mr. Palmer tells me that it has the habit of standing with its back exposed to the full glare of the sun, and in doing this stretches out its wings to their full capacity, apparently enjoying the " sun bath " in the highest degree.

Old vultures, when slightly wounded, have a way of " playing 'possum " so successfully that cases, not a few, are upon record where the device has saved their lives. Frequently, after gorging themselves upon carrion, turkey vultures will in numbers all fly up and alight upon the limbs of some great dead tree in the neighborhood, when, allowing their wings to hang down in a listless manner, they will sun themselves for hours, while the slow process of digestion is in progress. When kept in confinement they feed readily upon fresh raw meat, drink plenty of water, and are fond of standing in a gentle rain storm. They are likewise so careful of their plumage and so inoffensive in habits that one in time forgets that in nature they are naturally devourers of carrion. Where turkey vultures abound, however, I am inclined to believe it is only rarely that they devour putrid flesh, for an animal is no sooner dead and exposed in a favorable place for them than it will be immediately attacked by dozens of these birds at a time; so that even a horse will be devoured by the crew in an incredibly short period, and nothing left but the skeleton, and long before the flesh has an opportunity to decompose. It requires a heavy load of shot to down one of these vultures, and I have often seen one escape when I knew it had a small lead mine in the shape of No. 4's pretty equally distributed throughout its system.

Among the best of the earlier accounts given of the Turkey Vulture is that by Wilson, who remarked in his *American Ornithology* that in "New Jersey the Turkey Buzzard hatches in May, the deep recesses of the solitary swamps of that State affording situations well suited to the purpose. The female is at no pains to form a nest with materials; but, having chosen a suitable place, which is either a truncated hollow tree, an excavated stump, or log, she lays on the rotten wood from two to four eggs, of a dull dirty white, or pale cream color, splashed all over with chocolate, mingled with blackish touches, the blotches largest and thickest toward the great end; the form something like the egg of a goose, but blunter at the small end; length, two inches and three-quarters; breadth, two inches. The male watches often while the female is sitting; and, if not disturbed, they will occupy the same breeding place for several years. The young are clothed with a whitish down, similar to that which covers young goslings. If any person approaches the nest and attempts to handle them, they will immediately vomit such offensive matter as to compel the intruder to a precipitant retreat.

"The Turkey Buzzards are gregarious, peaceable, and harmless, never offering any violence to a living animal, or, like the plunderers of the *Falco* tribe, depriving the husbandman of his stock. Hence, though, in consequence of their filthy habits, they are not beloved, yet they are respected for their usefulness; and in the Southern States, where they are most needed, they, as well as the Black Vultures, are protected by a law which imposes a fine on those who wilfully deprive them of life. They generally roost in flocks, on the limbs of large trees; and they may be seen on a summer morning spreading out their wings to the rising sun, and remaining in that posture for a considerable time. Pennant conjectures that this is "to purify their bodies, which are most offensively fetid." But is it reasonable to suppose that *that* effluvia can be offensive to them which arises from food perfectly adapted to their nature, and which is constantly the object of their desires? Many birds, and particularly those of the granivorous kind, have a similar habit, which doubtless is attended with the same exhilarating effects as an exposure to the pure air of the morning has on the frame of one just risen from repose.

"These birds, unless when rising from the earth, seldom flap their wings, but sweep along in ogees, and dipping and rising lines, and move with great rapidity. They are often seen in companies, soaring at an immense height, particularly previous to a thunder-storm. Their wings are not spread horizontally, but form a slight angle with the body upward, the tips having an upward curve. Their sense of smelling is astonishingly exquisite, and they never fail to discover carrion, even when at the distance of several miles from it. When once they have found a carcass, if not molested, they will not leave the place until the whole is devoured. At such times they eat so immoderately that frequently they are incapable of rising, and may be caught without much difficulty; but few that are acquainted with them will have the temerity to undertake the task. A man in the State of Delaware, a few years since, observing some Turkey Buzzards regaling themselves upon the carcass of a horse which was in a highly putrid state, conceived the design of making a captive of one, to take home for the amusement of his children. He cautiously approached, and, springing upon the unsuspicious group, grasped a fine, plump fellow in his arms, and was bearing off his prize in triumph, when lo! the indignant vulture disgorged such a torrent of filth in the face of our hero that it produced all the effects of a most powerful emetic, and forever cured him of his inclination for Turkey Buzzards."

Wilson in this account omits to mention the great beauty of the eggs of this species; and, as I have said above, I feel sure that he is in error in regard to the manner in which vultures detect carrion. It is undoubtedly largely by the sense of sight and not that of smell, although the latter, as stated above, often greatly assists them. In commencing their feast upon a dead animal I have frequently noticed that they first pick out the eyes of the carcass and then attack the softer structures. Advancing putrefaction soon helps them out. If many of the birds are present at the entertainment they will, in the course of a few days, clean off the skeleton of either a cow or a horse, and then for over a week afterward sit round in the trees nearby, if there be any, or on the ground, contemplating their feat.

Dr. William L. Ralph, writing to Major Bendire, has said, "Many times I have seen these birds in company with the Black Vulture floating down a stream on a dead alligator, cow, or other large animal, crowded so closely together that they could hardly keep their balance, and followed by a number on the wing. I never have seen them fight very much when feeding, but they will scold and peck at one another, and sometimes two birds will get hold of the same piece of meat and pull against each other until it breaks or until the weaker one has to give it up." *(Life Hist. Am. Birds.)*

In the South, as in the Gulf States and the seaports and forests of the entire length of the eastern coast of Mexico, I have seen a far greater number of Black Vultures *(Catharista atrata)* than the Turkey Buzzards. The two species do not associate together, and by the careful observer are very easily told apart. Both in the matter of habits and flight they are distinctly different. Black vultures actually swarm in the neighborhood of many of our Southern cities. Around the slaughter houses below New Orleans I have been able to count as many as a thousand at a time; the ground, the fences, housetops, and many other places being black with them. They are as tame as barnyard fowls, and are by no means difficult to capture, though I advise against the experiment, especially if they have just been heartily feeding upon some offal, more odorous and ripe than otherwise. Wilson gives us some excellent accounts of these birds; in fact, he has been more widely quoted than any other one of our ornithologists who may have written of their natural history. Darwin, as well as Gosse, were likewise much interested in these famous birds, and contributed not a little to what has been published concerning them.

Bendire, in his work, has said "the Black Vulture is more or less gregarious in its habits at all times, breeding frequently in small communities, making little or no nest, and the eggs, usually two in number, are, perhaps with exceedingly rare exceptions, always placed on the ground, in canebrakes, under bushes, old logs, on rocks, and again in perfectly open and unsheltered situations. Occasionally but one egg will be laid, and very rarely three. In the more Southern States nidification begins about the first of March, and later northward.

"Probably but one brood is raised in a season. The young when first hatched are covered with light buff-colored down, and they are fed in the same manner as the young of the preceding species." [*C. aura.*]

None of our vultures have the restricted range that the California vulture *(Pseudogryphus californianus)* has, it being found only in a very limited area of the State the name of which it bears. Formerly this species was far more abundant, and had a much greater distribution. It is being rapidly exterminated; indeed, they are more than rare at the present writing. Nearly all the early describers of this great vulture gave its eggs as being *two* in number, and *jet black* in color. It is now well known that they are of a uniform tint, unspotted, and of a light grayish-green color. According to Bendire, "the mode of nidification of the California vulture is similar to that of the common Turkey vulture, and that as a rule they make but little of a nest, usually laying their eggs on rubbish on the ground found in the immediate vicinity of the nesting site, alongside or in a hollow log, or in crevices of rocky cliffs. It is possible that at times they make use of the abandoned nests of the Golden Eagles, which are common in that part of California, and the nest described to Mr. Flint as being placed in a large redwood tree in the Santa Cruz Mountains was probably such an one, and was made use of by the vultures after being abandoned by the eagles."

Some of the reports sent to Bendire, and published in his *Life Histories of North American Birds*, go to show that this vulture is likely to increase in numbers in the future, as its great thinning out in former years was largely due to its feeding upon the poisoned carcasses, placed as bait for the carnivora by cattle-raisers. This practice has, at the present time, been largely abandoned.

CHAPTER XVII.

SOME OF THE OWLS OF THE UNITED STATES.

(Striges.)

THERE is a very interesting list of owls in the avifauna of the United States and British America, while others occur in Mexico south to the Isthmus, that as yet are not known to cross our southern boundary-line. Of all these no species is handsomer, more graceful in action, or of greater value to man, than the American Barn Owl *(Strix pratincola)*, a form of very general distribution in this country, though not common in northern or northeastern sections. I have heard some people call this the monkey-faced owl, and others the white owl,—the latter from the fact that so much white occurs in its plumage. In Europe there is also a Barn owl very closely akin to our own bird, and at one time thought to be identical with it.

This species has a total length varying between fifteen and twenty-one inches, the variance being due to age or sex, or both. The white of the lower parts may be tinged with a bright tawny color, while the upper plumage is chiefly of a ochraceous-yellow with a continuous grayish tinge to it, the latter being more or less flecked and minutely spotted with white and neutral tint. The quills and tail feathers are barred, and the entire plumage has an extremely soft and delicate appearance, rendering the identification of the species a very simple matter.

The Barn Owl makes no nest, simply depositing its from five to seven ovate white eggs in any convenient cavity, as a hollow of a tree, corners in a steeple, tower, or barn, the burrows of such animals as the badger, holes in cliffs, and the like. Sometimes they lay large sets of eggs, but all of them do not hatch, as a rule. A young bird of this species, in the mounted collection at the Smithsonian Institution is nearly as large as the adult, having acquired most all of its plumage, but over the latter still curiously grows the feather-down,—and although by no means dense enough to mask it, yet gives the bird a very remarkable appearance.

Another owl that breeds more or less generally all over the United States is the American Long-eared Owl, which, together with the cosmopolitan Short-eared Owl, are the only two representatives in this country of the genus *Asio*—the first-named being the *A. wilsonianus* of science, and the latter *A. accipitrinus*. In my lifetime I have collected several specimens of either of these forms, but more particularly the short-eared one. Long-eared owls have the feather-horns very conspicuous,—ornaments that some authors call "ear-tufts," although they have nothing whatever to do with the ears of the bird. *Asio accipitrinus* has these feather-horns very small, and when one comes to handle a recently shot specimen they are hardly at all apparent. They only show when in life the bird becomes excited and erects them to their utmost, while at the same time the other plumage of the head is depressed. For one to indentify either of these two species it must be remembered that we have no other mottled, streaked and banded, dark-plumaged, very conspicuously tufted owl in this country that has an average of only thirteen to sixteen inches, except the American Long-eared Owl,—while the short-eared one averaging but a trifle larger, with its tawny plumage, boldly striped with dark brown, can easily be told, when adult, by its rudimentary feather-horns. All owls lay white eggs that are usually ovate in form, approaching the spherical very closely in some examples.

The Long-eared Owl commonly lays five eggs, the white shells being finely granulated and rather glossy; and according to Bendire this bird "rarely constructs a nest of its own; usually the last year's nest of a crow is slightly repaired by being built up on the sides and lined with a little dry grass, a few dead leaves, and feathers; some of the latter may nearly always be seen hanging on the outside of the nest. Fully three-fourths of the nests found by me occupied by these owls were those of the Crow. Only a very few were evidently built by the birds themselves."

Strange to relate, both Barn Owls and the long-eared species have, in either case, been met with occasionally in flocks. Mr. B. W. Evermann, formerly of the United States Fish Commission, once saw in California more than fifty of the former in a flock among oak trees; while as many as fifteen of the latter have been found in one tree at a time.

At this writing I have before me a fine living specimen of a subadult Long-eared Owl, kindly loaned me by Mr. Ed. S. Schmid, the proprietor of the Animal Pet Emporium, of Washington, D. C. When first obtained the bird was largely in late nestling plumage, but during the fortnight it has been in my keeping all the feathering of the breast and back has come out as in the adult. The entire top of the head is as yet *woolly* as in well-advanced nestlings; while the feather-horns or tufts are but still rudimentary. This bird is taming nicely, and readily feeds upon raw meat, sparrows, mice, etc. During the month of June, 1897, I made several fine photographic pictures of this young owl, and of these two are reproduced in the present chapter as illustrations.

In Fig. 59 the bird is standing erect, facing and closely watching the person near him (I say him, but this individual may be a female), while in Fig. 60, a crouching and defensive attitude has been assumed, caused by my teasing, in order to secure it. As is well known, owls disgorge from time to time peculiar pellets composed of the indigestible portions of their food, as small bones, hair, and feathers. This owl has disgorged two or three of such pellets since having been in my possession. Each was about as big as my thumb, and made up of sparrow feathers and bones; the latter including the entire skull, the limb-bones, and the main ones of the trunk skeleton. This ejection of pellets by the mouth of this kind is done by all owls, "excepting possibly the little Elf Owl," as Bendire says in his *Life Histories of North American Birds.* Most frequently this species roosts in some dense tree or shrub during the daytime, in the immediate vicinity of water. Years ago, during one winter's day, I surprised one of these owls in a close growth of small hemlocks near Stamford, Connecticut. Upon seeing or hearing me it drew itself up to its full height, and, pressing its feathers close to its body, and erecting its feather-horns to their fullest capacity, it appeared as long and slender as possible; and as it made no movement whatsoever, I came near mistaking it for a longish dead limb of the tree upon which it was perched. At the time the thermometer stood several degrees below zero, the ground being covered with snow, and my hands and fingers were utterly benumbed with the biting cold. The timber was so dense that I backed away from the fellow with decided difficulty, holding onto, at the same time, my old muzzle-loading and ice-cold gun, a shot from which, a few moments later, decided the fate of that very handsome owl. Winged, it tumbled down into the snow, and I made a rush for it, and incautiously seized

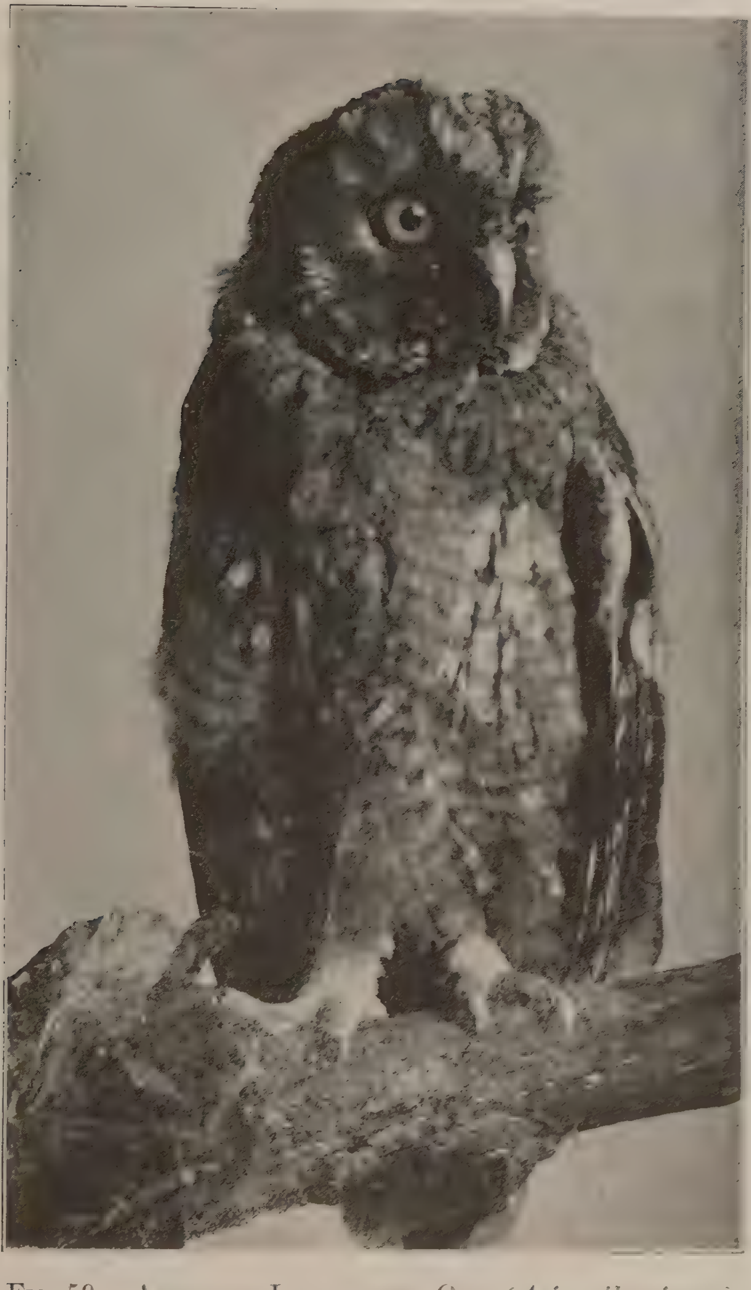

FIG. 59. AMERICAN LONG-EARED OWL (*Asio wilsonianus*).

Subadult. Photographed one-half the size of life, from the living specimen, by the Author

it by the sound one of the opposite side, when as quick as a flash it had all eight of its claws—sharp as needles, too—plunged into my nearly frozen and naked hands. There was a lively tussle before that owl and myself, together with the gun, and

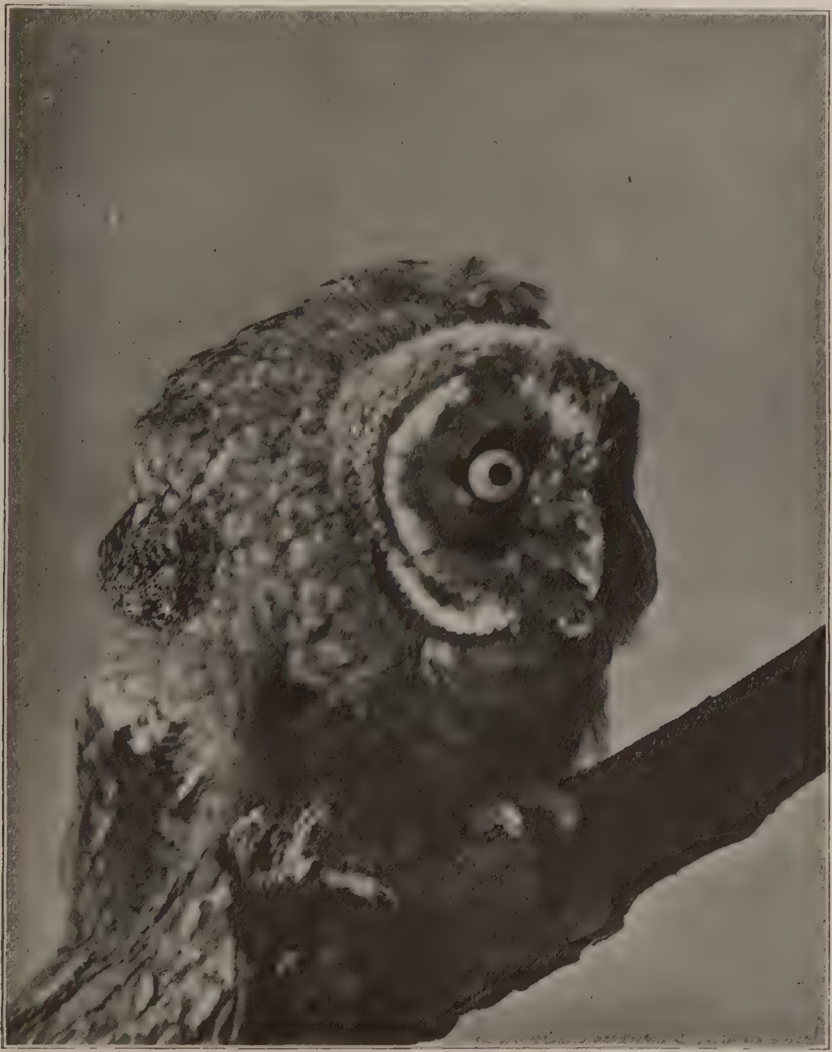

FIG. 60. THE LONG-EARED OWL (*Asio wilsonianus*).

Subadult. Same specimen as shown in Figure 56. Photographed from life (one-half size), by the Author.

collecting basket, were out in the clear once more. But we got there, and his mounted owlship long adorned the top shelf of my book-case at home afterward.

Bendire in his work devotes a long paragraph describing the defiant attitudes assumed by this species, when annoyed or surprised, after it is aware that it has been discovered. One of these attitudes is beautifully shown in Fig. 60 of this chapter Frequently they are even more ferocious-appearing than this, and in one instance I secured a photograph that shows the bird all puffed up like a great, round ball of feathers. This picture I will publish in some other connection.

Owls both screech and hoot, but they likewise make a great many other kinds of notes and noises, some of which are by no means unpleasing to the ear. Nearly all of them snap their mandibles together when irritated, an action often followed by hissing sounds in some species, with certain bobbings and noddings of the head most ludicrous to behold. Short-eared owls, at variance with most all other *Strigidæ*, are birds that frequent the more open parts of the country, are largely diurnal in habit, spend the greater part of their time, while not on the wing, on the ground, where, usually in April, this species builds its nest of grass in which it lays from four to seven eggs. Small rodents, rarely birds, constitute the food of the Short-eared owl, and in so far as man's interests are involved, the bird is deserving of his best protection. Upon several occasions I have shot this species on cold moonlit winter's nights, when they flew low over the snow hunting for mice. Two I especially remember now that I shot in the winter of 1872, near New Canaan, Conn., on such a night, as they flew circling about a great vacant field, with not a tree in it. Whenever one of the pair passed me it would rise higher in the air, and give utterance to a peculiar clucking noise, probably prompted by its surprise.

Of all the owls in this country, the biggest of body, and by all odds the most destructive and powerful is the well-known Great Horned Owl, called also in certain localities the Cat or Hoot Owl *(Bubo virginianus)*, a species which has a geographical range through eastern North America, south to Costa Rica. Three subspecific forms are also known of this bird, namely, the Western Horned Owl *(B. v. subarcticus)*, the Arctic Horned Owl *(B. v. arcticus)*, and the Dusky Horned Owl *(B. v. saturatus)* of the Pacific coast region. As in the case of the majority of the family, the female of this species is a far stronger bird than the male, and will doubtless, when pressed by hunger, fall upon, kill, and eat him, as has been noticed several times when pairs of these birds have been kept in captivity.

No known owl in the world gets away with more game, chickens and other domestic fowls, together with a long list of medium-sized mammals and fish, than does this untamable, tyrannical, and blood-thirsty demon of the night. They are the princes of nocturnal raptorical hunters, being keen of eye, powerfully equipped with merciless talons, it is the rarest thing that they ever go unprovided with food, or fail to amply supply their big, down-covered, voracious young. When the hunting is at its best these birds only deign to eat the heads of their victims, seeming to kill just for the pleasure of the act.

The deep and bass-voice hooting of this species is as familiar to sportsmen and bird lovers, as is the appearance, form, and size of the owl itself. During the winter of 1882 or 1883 I pulled in an open boat with three companions forty miles down the Alabama river. It took the best part of the entire night, which was a pitchy dark one, and for nearly all the distance the banks of the river were heavily timbered. In some places we were obliged to pull under the low sweeping limbs of the cypress, from which swung masses of the moss called " Spanish beard." Every once in a while a Great Horned Owl would hoot out, and make the very forests echo with his uncanny cry. For some time none of these were very near, but about an hour after midnight, during a lull, when the party had hardly spoken a word for a long while, and the boat was passing near the bank in the very deepest of the shadows of the night, one of these ponderous owls gave full vent to his unearthly hoot from a limb not ten feet directly above our heads. Out it rang in all its unchecked vigor,— " who-who-cooks-for-you—who,"—and the effect upon the boat's company was pretty much the same as though a royal Bengal tiger had suddenly pounced down among us, and propounded some similar impertinent interrogatory. This owl breeds in hollow trees, in the deserted nests of the larger diurnal raptores, rarely upon the ground or in hollow logs upon the same, and in the clefts of rocks, and similar places. The set of white eggs, of rounded oval form, usually numbers from two to three only, and they take about twenty-eight days to hatch. There is a great deal in the history of this bird of a very interesting nature, and much has been recorded in type about the species. I have seen very little of the northern and western subspecies, but upon one occasion I remember, when serving as post surgeon at Fort Fetterman, many years ago, I came suddenly upon a pair of these birds,—the Western Horned Owl—as they simultaneously flew out in great haste from some heavy undergrowth upon a river's bank immediately below where I stood. My surprise was so great that I almost intuitively sent my gun to shoulder, and cracked away at them,—a bird promptly falling to each barrel. Both the buff and gray tints of their plumage were very light in color, and the entire bird in these respects differed considerably from its eastern congener. Subsequently I found this owl to be more or less abundant in the vicinity, and always fat and heavy, as the country was full of grouse and small game.

Another well-known owl of this country of which I recently have had an example in captivity, is the Barred Owl *(Syrnium nebulosum)*. The specimen with another of the same brood were captured near Washington, D. C., and, for owls, they proved to be very gentle and not altogether uninteresting pets, differing in the first particular very markedly as compared with the young Long-eared Owl. Photographs of this nestling *Syrnium* were made by me with good success, in a variety of attitudes and characteristic postures. Two of these are reproduced here.

In the genus to which this species belongs, there are also to be found a sub-species *(S. n. alleni)* and the Spotted Owl *(S. occidentale)*; the first being a coastwise form, occurring from South Carolina to Texas, the second, ranging over southern Colorado, New Mexico, Arizona, the Californias, and Mexico. Typical Barred owls occur in eastern United States, west to Minnesota, and northward to Nova Scotia.

To identify a bird of this genus, we have but to remember that they are large, bulky owls, without any feather-horns whatever, and with the irides of the eyes *nearly black*, with a bluish tinge in life. For the rest they are dark brown about, being barred and spotted with buff and lighter color. The tail is six to eight banded, and the wings spotted and otherwise marked. Below, the parts are whitish or buffy, and are likewise barred, and spotted with shades of brown. The young also show much barring in their plumage, as will be appreciated in my photographic reproductions illustrating the present chapter.

The female is markedly larger than the male bird, exceeding

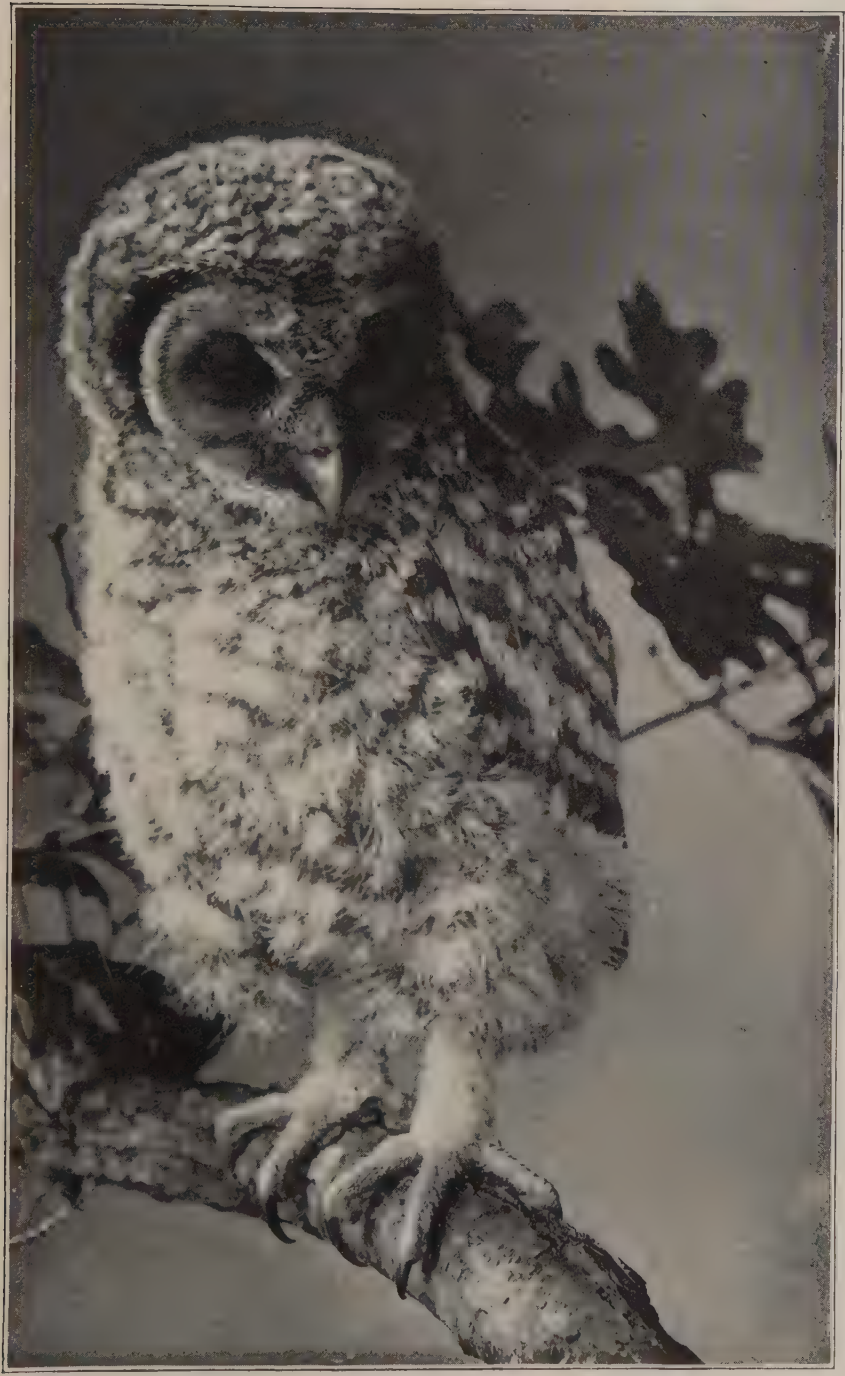

FIG. 61. NESTLING OF THE BARRED OWL (*Syrnium nebulosum*).

At the time of leaving the nest. Considerably reduced, and photographed from life by the Author.

it by several inches in length: in both the bill is of a greenish yellow, being more grayish in the young. Florida Barred Owls I found to be very numerous in the neighborhood of New Orleans, La., where in the depths of the cypress swamps and bayous, I have observed several in sight at one time. Nocturnal in habit by preference, this species nevertheless occasionally hunts by day, its principal food being small mammals, some birds, frogs, fish, and snakes; and finally a varied list of insects and other invertebrates. Water is greatly relished by them, and in captivity they will frequently bathe. Their notes are simply extraordinary in many particulars, some of them being uttered in the daytime. They build, or rather lay their eggs in holes in trees usually, but sometimes select for the purpose an abandoned nest of crow or hawk. In flight they are absolutely noiseless, passing through the air with scarcely any more disturbance than a feather falling in the same medium. Many years ago, I found the Barred Owl very abundant in the heavy timber-forests a few miles from Kingston, New York, and Wilson in his time found them to be very common in the lower parts of Pennsylvania, having met with forty specimens in one spring. His account of the different character of the feathers of this species is quite interesting.

Another very large owl that occurs in the northern parts of this country in the winter time is the Great Gray Owl *(Scotiaptex cinerea)*, a visitant from the arctic realm. A subspecies of it has accidently occurred in Alaska *(S. c. lapponica)*. As yet we have but limited information in regard to these two forms, and any one supplying accurate accounts about them will be doing science a good service. Recently I have obtained from Mr. Albert Lano of Aitkin, Minnesota, the trunk skeleton of *S. cinerea*, and this is notably smaller than the same part of the skeleton of either the Snowy Owl or the Great Horned Owl, yet the Great Gray Owl exceeds both of these birds in length, the difference being due to the feathers and excessive development of the plumage in it.

This fact was made the subject of a letter from Mr. Lano, and other naturalists have observed the same, Bendire remarking upon it in his work. No feather-horns ornament the head in *Scotiaptex*, and this taken in connection with its great size and other characters easily distinguishes it from any of the large owls of our avifauna.

Of these latter, quite distinct again is the well-known Snowy Owl *(Nyctea nyctea)*, one of the handsomest of the great boreal landbirds, occurring as it does in all the northern portions of the northern hemisphere.

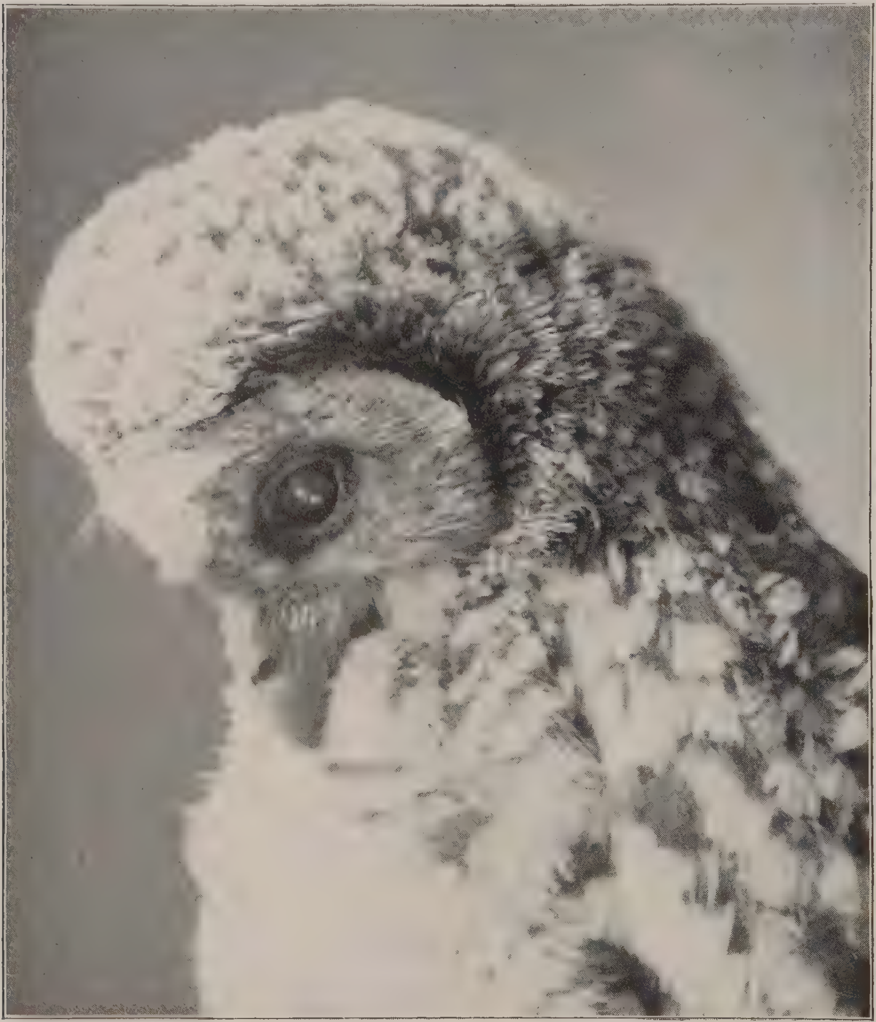

FIG. 62. LEFT LATERAL VIEW OF THE HEAD OF A YOUNG BARRED OWL (*Syrnium nebulosum*).

Nearly natural size. Usual manner of posing the head when regarding objects below. From a photograph from life by the author. (Same bird as in Figure 61.)

Wherever seen, this owl is sure to command the attention of the observer, be it a mounted specimen or even a skin in an ornithological collection, and still more when met with in its wild native haunts. There is no trouble in identifying the Snowy Owl under any circumstances: its great size, its pure white plumage set off with bars and spots of slaty brown, and the absence of feather-horns are alone sufficient to render identification certain. The male is smaller and much whiter than the female, some specimens being almost immaculate. Young birds of this species are of a deep sooty grayish color, and like the parents heavily feathered all over from base of beak to the claws. On the old birds the plumage is especially dense and generous, forming a coat so warm that the owner is capable of braving the severest of arctic weather without the slightest discomfort. This bird hunts by day and nests on the ground, and seems to take the greatest possible delight in capturing his prey. Swift of wing, arctic hares are taken by it, almost invariably when attempting to escape at the top of their speed, and it is said, doubtless with truth, that the bird prefers to flush a ptarmigan and pursue it rather than pounce upon the squatting fowl as a Great Horned Owl would do. Wilson remarks "Unlike most of his tribe, he hunts by day as well as by twilight, and is particularly fond of frequenting the shores and banks of shallow rivers, over the surface of which he slowly sails, or sits on a rock a little raised above the water, watching for fish. These he seizes with a sudden and instantaneous stroke of the foot, seldom missing his aim." This owl is often harassed by other birds during the daytime as other owls are, and early in the 60's I remembered having seen one upon the outskirts of a piece of pine forest, where a perfect battalion of blue jays, and a motley mob of some forty crows were making life miserable for him. His attackers were very cautious however, and it was quite possible that the drama closed with a tragedy,—the owl making short work of one or more of his corvine tormentors.

Among the medium-sized owls of the country we have the Hawk Owls, and of these there are two,—the European form *(Surnia ulula)*, a casual in Alaska, and the American Hawk owl *(S. u. caparoch)* confined to arctic America, and migrating only in winter to the northern boundaries of the United States. This is a dark-colored bird (black and brownish) with spots and motlings on the wings, and bars on its long tail. There are no feather-horns, and in habit the species is a diurnal one. Much in its history, so far as at present known, is extremely interesting, and for what we have of it we are chiefly indebted to our northern explorers. Sometimes they build a nest of their own or they may simply deposit their eggs, from six to seven in number, in the hollow stump of a tree, without making any nest whatever. They are fearless in the defense of their young or eggs, and will attack a man without hesitation if molestation on his part be attempted. The bird is easily captured, even in some rare cases by the hand alone. In the Yukon district, Turner approached within six feet of one sitting on a post, and only induced it to fly after loud shouting and throwing a stick at it; while Dall, when engaged in taking a set of its eggs in Alaska, had his cap knocked off his head by the bird making a fierce dash at him. Hawk owls prey upon small mammals, rarely birds, and insects. Science stands in need of a fuller history of this species.

Apart from those thus far referred to, all the remaining species and subspecies of owls in this country are comparatively small forms, and more or less numerous in kind. Some of them are the veriest pigmies of the family with histories that even the most indifferent student of bird-life among us must read with pleasure and entertainment.

Saw-whet Owls are rather small of size, ranging from seven and a quarter inches in length to twelve, being without feather-horns, brown in color above, more or less white-spotted, and white on the under parts, where they are striped with brown. In the northern part of the country we meet with, in the winter-time, Richardson's Owl *(Nyctala tengmalmi richardsoni)*, but the best known species of the genus with us, is the common Saw-whet Owl *(N. acadica)*, which inhabits North America at large, and in the western mountain ranges passes south into Mexico.

The bird gains its name from its note, which resembles the filing of a saw, and this is not difficult to imitate and thus lure the performer thereby, making its capture an easy matter. In the woods they are wonderfully tame and unsuspicious, allowing themselves to be stroked by the hand as they sleepily roost upon their perches. This has been accomplished by numerous ornithologists in the field, and many specimens have thus been taken alive. They prey principally upon moles and mice, and other small animals, and are extremely useful in aiding to check the undue increase of such forms in nature.

But the Burrowing Owls of the western plains and southern Florida *(Speotyto cunicularia hypogæa* and *S. c. floridana)* are probably the greatest enemies that the rodents of the region in which they live have among all the birds of this family. In fact the Burrowing Owl of the west actually takes up its camp directly upon the ground where its principal prey lives in communities, and it, with its voracious young, absolutely kill and consume thousands of various species of terrestrial squirrels every year, such as prairie dogs, spermophiles, and chipmunks, to say nothing about the gophers, mice, snakes, the destructive black crickets, and many other kinds that constitute their prey. Bendire, who, in my opinion, has written the best account of the life history of this owl now extant, has proved that each individual bird will eat fully its own weight, or more, in food of the above character every twenty-four hours, and his work upon the birds of this genus will have more to do with contradicting the ridiculous stories about the happy and harmonious living together of rattlesnakes, prairie dogs, and owls in the burrows of the dogs, than anything that has appeared in print. During the time I was collecting my material in the west for a complete account of the anatomy of this owl, I had abundant opportunity for over five years to study *Speotyto* every day, and I can attest to the excellence of his work and the truthfulness of his statements.

Passing to the Screech Owls of the genus *Megascops* we find them represented by no less than two species and nine subspecies, with the group through these occurring in suitable localities in every part of North America. These owls are so well known in nearly all particulars to those who take any interest in birds whatever, that descriptions here would be quite superfluous. What the ornithologist still demands fuller information about however, is the cause of the distinct variation in the plumage of the members of this genus. There are two well-marked phases of this, the rufous and the gray, and it is not at present understood to what these differences are due. Hence Screech Owls are likewise called Mottled, Red, or Gray Owls, depending upon the phase of plumage they happen to be in at the time. The very young nestlings are white, resembling little puff-balls of down. Speaking of Screech owls reminds me of a curious incident in regard to one of them that occurred within my own personal experience. At the time referred to, I was not more than fourteen or fifteen years of age, and my entire spare time was given over to making a collection of birds of the neighborhood where my parents lived. Frequently I was up long before daylight and out in the field or forest, and sometimes did not return home until eight or nine o'clock in the evening. Upon one of these latter occasions, and when within a very short distance of the house, I shot at a Screech owl in a neighbor's appletree. It fell in the soft snow that had fallen during the day, and as I picked its apparently lifeless body up, I saw that it was one of the rufous-plumaged varieties. My specimen was at once consigned to a pocket in my gunning-coat, and I hastened home in order to be present at family prayers in the evening, as my good mother desired this, in order not to offend my reverend uncle, who was a very distinguished man in the Episcopal faith, and a guest with us at the time. His aged mother, my grandmother, was also with us, and she was an extremely devout old lady indeed, too, and invariably frowned upon any member of the family that failed to appear promptly at evening prayers. As I hastily entered the dining-room I realized at once that I had earned a black mark in my grandmother's estimation, as the entire family—brothers, aunts, guests and all, were down kneeling at the chairs, and uncle was apparently half way through the service of the hour. Hastily slipping on my wrapper, and tossing my gunning-coat upon a sofa in the corner of the room where they were assembled, I, too, as quietly as possible knelt at my chair, and this latter happened to be so placed that I could see my coat where I had laid it. Uncle prayed long and well, and had a way of pausing, for a moment or more, between his sentences. During one of these periods of deathly silence, I noticed a peculiar movement of my gunning-coat, that soon became more and more vigorous, to terminate in the sudden emergence of my owl, who, having at last mastered the mysteries of the abnormal cavity he was in, bounced out to sit bolt upright upon the garment. Angrily he clicked his mandibles; wildly he stared about the room; and politely he ducked his head to every one present there. But clickings, bows, and stares were all lost, save upon myself and two brothers, who likewise had caught sight of his resurrected owlship, and were doing their best to smother their laughter. Uncle's mind as well as those of the ladies were far, far off in the regions of space. The owl had evidently never seen anything like this before, human or otherwise, and having sufficiently recovered his senses, and the knockdown he had gotten from my shot, he, as noiselessly as a puff of smoke, sailed thrice about the room, to alight upon an unlit burner of the gas-chandelier overhead. Not satisfied with this performance however, nor the misery myself and brothers were in to keep silent, he quickly essayed another aerial survey, and that not a lofty one, but, to my horror, low down and close to the kneelers. Having taken in the situation to his satisfaction, he was evidently rolling round in his mind where he would alight a second time. This to my infinite concern, and much distorted feelings, he soon settled, for with a lightness that none but an owl can equal, he gracefully lit upon the thin white cambric cap that ornamented my grandmother's head. Instantly her hand was carried there to discover the cause of the unusual interruption, and this movement, so unexpected, nearly frightened the owl into fits. What followed all happened within a second or two. The owl could not clear his sharp little talons from the head-dress, so he, with all his might, drove their eight needle-like points firmly into grandma's scalp. Uncle was in one of his long, most devout pauses, when the unearthly shriek burst upon the silence of the room, mingled as it was with the brutal outburst of long suppressed merriment of my brothers and, the funniest of all, the peculiar Indian-like yell that my uncle let loose, which of itself was sufficient to break up the entire meeting.

In the west and southwest we meet with the most engaging members of the whole family *Strigidæ;* I refer to the little Pygmy and Elf owls. They belong to the genera *Glaucidium* and *Micropallas*,—three species and a subspecies in the first, and a single species in the second. Some of these are no bigger than sparrows, and have wonderfully interesting habits and history, but accounts of these would far exceed the limitations of the present chapter.

CHAPTER XVIII.

THE CAROLINA PAROQUET AND OTHER NOTES.

(*Conurus carolinensis.*)

WE have but one species of paroquet in the avifauna of the United States—the pretty little green Carolina paroquet, with its red and yellow head. Formerly this bird had a very general distribution all over the eastern part of the country, from Texas and Colorado to the Atlantic coast line. It is at the present time, however, nearly extinct, being confined to extremely local areas in Florida, Indian Territory, and Arkansas.

This killing off of one of our most beautiful birds has been almost entirely due to man's agency, and in a few years more not a living specimen of this species will be in existence. It seems quite incredible that this slaughter should have occurred in so short a space of time, especially when one comes to read of its great former abundance in the very interesting account left us by Wilson and others. Not long ago a beautiful pair (♂ and ♀) of those paroquets came into the possession of Edward T. Schmid, the proprietor of the well-known bird emporium of Washington, D. C., who, with marked generosity, permitted me to take them out to my home for the purpose of making photographs of them. The birds were in beautiful plumage, fine health, and in full possession of their powers of flight. After studying their cage habits for a few days, I made my preparations to take their pictures.

In life these paroquets are extremely fond of the seeds of the plant commonly known as the cocklebur (*Xanthium strumarium*, Linn.), and I was determined to secure my photographs with the birds shown upon a specimen of it. Without much difficulty examples were found growing in vacant lots about Washington, and a good big bunch brought to my studio. At the outstart, however, I had no idea of the trouble that was before me ere I succeeded in securing even a passable picture of these birds. But my stock of patience is great, and my enthusiasm unlimited, when the subject happens to be a form so near extinction as is this bird. There is a certain fascination that irresistibly controls the student of nature when he appreciates the fact that he

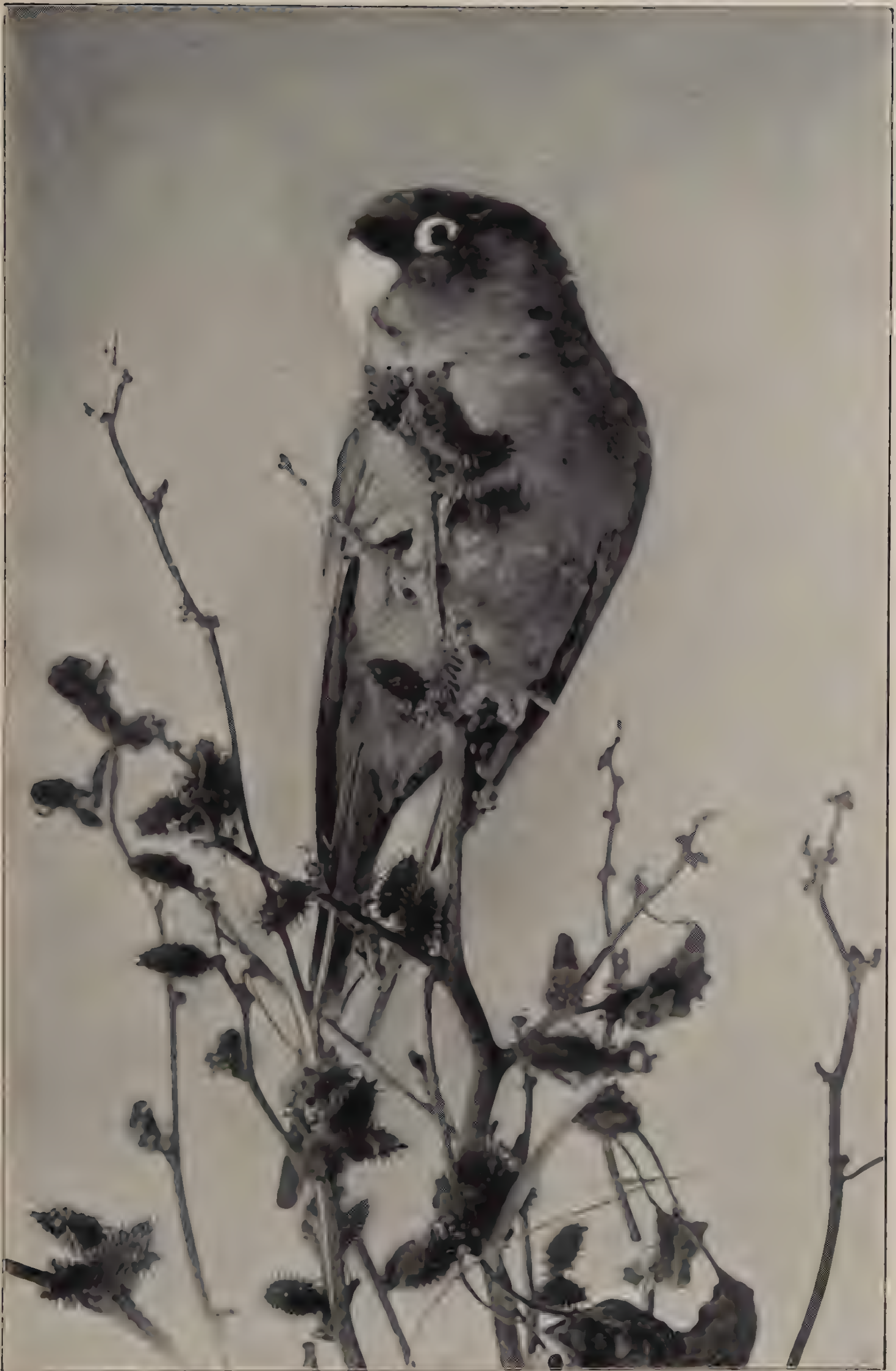

Fig. 63. Carolina Paroquet (*Conurus carolinensis*).

Two-thirds natural size. From a photograph from life by the Author.

is engaged upon the task of making a photographic picture of a form, living examples of which will cease to be within possibly the span of his own lifetime. There are not a few hand paintings or drawings of the Carolina paroquet extant, but I very much doubt that anyone has, as yet, made and published photographs of them; certainly not as they have been perched upon twigs of the *Xanthium.*

Upon taking the cage containing these birds into the room prepared for my work, they exhibited a very considerable amount of restlessness, and when they came to understand that I intended to let them out, they at once showed a high degree of excitement. Screaming hardly expresses the nature of their penetrating notes, that could easily be heard a square away. After receiving several severe bites through the fingers of a thick pair of gloves, wherewith I had undertaken to protect my hands, they were finally turned loose in the room. Here they flew about in the wildest possible manner, despite all my efforts to quiet them down; alighting on the tops of the window curtains, the camera, and even my own person, and were not content until they had knocked over the stand containing the bunch of cockleburs. Next—whang! they both flew against the big window pane, and then down on the floor, only to waddle off and try to climb up the legs of my tripod.

Quietly putting things to rights again, I waited in patience for a subsidence of their excitement, when to my intense satisfaction they both flew from the top of the door and lit on the cockleburs, as I wanted them. Here was new trouble for me, however, for the presence of their favorite food set them off again, and I thought they would pull off every single seed pod before I could get a snap on them. Trial after trial was now made without success, and three or four hours had passed without a good result, and, as the light was going fast, I determined to try a single bird, rather than not have anything. The result of this attempt is reproduced as an illustration to the present chapter, and it gives a very good idea of the form of our *Conurus.* To get the brilliant red and yellow of the head and the bright green body is of course out of the question in a photograph. What may be done in this way in years to come is another matter, and one of the problems for solution by the photographer of the future.

The following two or three days were cloudy, and so my plans to make more trials were frustrated. The price of the birds ($20), too, had a soothing effect upon my shallow purse; for, to tell the truth, I felt terribly like photographing this pair of pretty little green rascals with my shotgun, upon more occasions than one. As it was they were returned to their owner at an unfortunate time, for a number of his cages had been repainted, and to one of these the paroquets were consigned. During the night they both nibbled off a quantity of the fresh paint, which proved a fatal dose.

A number of years ago I published in London an account of the skeleton of this paroquet, illustrating my work with lithographic plates; but so far as I know, the other systems of its anatomy have not been touched upon. It is not likely, of course, that its structure departs very much from other representatives of the genus; still, this supposition should have no weight, and its anatomy should be fully described ere the species becomes totally extinct. There have frequently been morphological surprises, even in closely allied forms, and to this our Carolina paroquet may offer no exception. As usual, only skins were made of this pair, and "the characters thrown away." Many skins of the form are now to be found in museums, and perhaps a few alcoholic specimens are in existence.

It is exceedingly interesting to read the admirable account of this species left us by Wilson, to whom the bird was also known as the "Illinois Parrot." He writes without a shadow of suspicion as to the utter extinction that awaited the species in our time. He speaks of it as being *resident* as far west as he knew the country, and as far north in one direction as Lake Michigan, adding," from these circumstances of the northern residence of this species, we might be justified in concluding it to be a very hardy bird, more capable of sustaining cold than nine-tenths of its tribe; and so I believe it is,—having myself seen them, in the month of February, along the banks of the Ohio, in a snowstorm, flying about like pigeons, and in full cry." Wilson also very vividly describes the immense flocks of them he met with at Big Bone Lick in Kentucky, where, when "they alighted on the ground, it appeared at a distance as if covered with a carpet of the richest green, orange, and yellow." Their beautiful, swift, and graceful flight he refers to with great truthfulness; and speaking of this reminds me of what Mr. Robert Ridgway, the ornithologist, told me not very long ago. He had met with a flock of these paroquets in a certain locality in Florida, during a visit in the winter of 1896-97. While standing in thickish cover, near a small sheet of clear spring water, the flock of birds dashed in to drink. This they accomplished by all hovering together over the surface of the spring. The sun at the time shown in directly upon them, and, as Mr. Ridgway says, with the effect of not only reflecting the beautiful picture of these elegant forms into the water, over which they gracefully sustained themselves *en masse*, while they drank of it, but at the same time enhanced to a marvelous degree the exquisite tints of the birds themselves.

Personally, I have seen this paroquet alive in a wild state only a few times. Once, I saw a single specimen in a cornfield in the eastern part of the State of Kansas. It was early in the 80's. I have, up to the present time, never collected the bird.

Further on in his account Wilson says " they are particularly attached to the large sycamores, in the hollow of the trunks and branches of which they generally roost, thirty or forty, and sometimes more, entering at the same hole. Here they cling close to the sides of the tree, holding fast by the claws and also by the bills. They appear to be fond of sleep, and often retire to their holes during the day, probably to take their regular *siesta*. They are extremely sociable, and fond of each other, often scratching each other's heads and necks, and always, at night, nestling as close as possible to each other, preferring, at that time, a perpendicular position, supported by their bill and claws." This nestling as close together as possible while in the hollow trunk of a tree, I purposely quote, because we find in the Ornithological Hall of the Smithsonian Institution a large hollow trunk of a tree, in the inside of which a number of mounted specimens of the Carolina paroquet have been placed, clinging to the inner surface in the manner described by Wilson, with the exception that the individuals have been suspended at very unsociable distances apart, something, I am quite sure, these birds would never have been guilty of in a state of nature.

When these paroquets were plenty in this country a very general opinion prevailed that their heads and intestines, if eaten by cats, would surely prove fatal to them. This was universally said to be because the cockleburs upon which the birds so commonly fed would invariably act as a fatal poison to the aforesaid felines. Wilson tried many times to prove or disprove the truth of this statement, but usually some trivial circumstance stood in the way of his success. Either the cat could not be secured at the time, or the paroquet had not been feeding upon cocklebурs, or something else of the kind. After a long talk upon the subject he closes by saying, "Since the foregoing was written, I have had an opportunity, by the death of a tame Carolina paroquet, to ascertain the fact of the poisonous effects of their head and intestines on cats. Having shut up a cat and her two kittens, the latter only a few days old, in a room with the head, neck, and whole intestines of the Paroquet, I found, on the next morning, the whole eaten, except a small part of the bill. The cat exhibited no symptom of sickness; and, at this moment, three days after the experiment has been made, she and her kittens are in their usual health. Still, however, the effect might have been different had the daily food of the bird been cockleburs instead of Indian corn." From this, I think it is clear that Wilson never did quite satisfy himself upon this point, or if he did, he never published the fact. He did seem to prove, however, that while using their feet in feeding, some of these birds were naturally left-footed, as it were, as others were invariably right-footed.

Bendire, in his *Life Histories of North American Birds*, has left us an excellent contribution to the natural history of this species. In that account we read that formerly when the birds were extremely abundant in Florida, a reliable observer there "used to find them breeding in large colonies in the cypress swamps. Several of these colonies contained at least a thousand birds each. They nested invariably in small cypress trees, the favorite position being on a fork near the end of a slender branch. Every such fork would be occupied, and he has seen as many as forty or fifty nests in one small tree. Their nests closely resembled those of the Carolina dove, being similarly composed of cypress twigs put together so loosely that the eggs were often visible from the ground beneath. The twigs of the cypress seemed to be preferred to those of any other kind of tree. The height at which the nests were placed varied from 5 or 6 feet to 20 or 30 feet."

The eggs were described by this observer "as being of a greenish-white color, unspotted. He did not remember the maximum number which he had found in one set, but thought it was at least four or five. He had often taken young birds from the nests to rear or to give to his friends." To this Bendire adds the remarkable statement that "We have no positive information about the number of eggs laid by this species in a wild state. . . . Mr. Robert Ridgway's birds would not use the nesting boxes provided for them, and both females deposited their eggs on the floor of the cage; they were laid in July, August, and September, respectively. None of these eggs can be called round; they vary from ovate to short ovate, and are rather pointed. They are white, with the faintest yellowish tint, ivory-like and quite glossy; the shell is rather thick, close grained, and deeply pitted, not unlike the eggs of the African Ostrich *(Struthio-camelus)*, but of course not as noticeable. Holding the egg in a strong light, the inside appears to be pale yellow." Bendire succeeded in getting together very considerable information in regard to this species, and, with others in his work, printed the usual prediction that "the total extermination of the Carolina paroquet is only a question of a few more years, and the end of the present century will probably mark their disappearance."

It may be safely predicted that all birds all over the world are upon the road toward extinction, but some are very much nearer to that fate than are others. Besides the Carolina paroquet in this country, the Roseate spoonbills *(Ajaja ajaja)* are nearly gone, and so are some of the other waders. Wild turkeys and many other game birds are rapidly being shot out, and the Passenger pigeon *(Ectopistes)* is now rare where it formerly existed in millions. Skins of the California vulture *(Pseudogryphus californianus)* will fetch $100 each, and so does an egg of the same species, while some of the raptorial birds are becoming very scarce. Ivory-billed woodpeckers are nearly gone, and the Pileated woodpecker will doubtless meet with the same fate later on, while every now and then we hear of the threatened extinction of even some of the smaller passerine types, as occurred not long ago in the case of the bluebird.

But we must not carry our paragraphs here into the realms of philosophy, and be tempted to draw pictures in futurity, of times when there may be nothing remaining save man and the English sparrows, with all that remains of our forests converted into fancy parks and preserves.

So much for what I have to say about the present status and probable extinction of the Carolina paroquet, but it is believed by not a few that we have within the boundaries of the United States still another representative of the family *Psittacidæ*, or parrots. This is the Thick-billed Parrot *(Rhynchopsitta pachyrhyncha)*. On page 330 of the 1895 edition of the A. O. U. Check List, in the "hypothetical list" of species, we find this form there recorded, with the somewhat remarkable statement beneath it, to the effect that " There is said [*sic*] to be a specimen in " the collection of the Philadelphia Academy of Natural Sciences, labeled Rio Grande, Texas, J. W. Audubon, "but there is doubt as to whether the specimen was really taken within the limits of the United States. Its occurrence in Texas is not improbable, but the evidence is unsatisfactory."

Judging from the name of the collector, I should think the *evidence* might be both unsatisfactory as well as unreliable, as the compilers of the aforesaid A. O. U. Check List candidly aver. In reference to the occurrence of this species within the boundaries of this country, I would further say that my attention has been called to what Mr. Robert Ridgway says on page 269 of his 1887 edition of *A Manual of North American Birds*, where that eminent ornithologist states that the species occurs in " southwestern Texas and southern New Mexico." A footnote to this goes to show that from a letter of mine written to Mr. Ridgway, I am held accountable for its having been seen in New Mexico. The words of the letter are not given, nor do I fully recall them, but I do know that personally I never saw the Thick-billed parrot in New Mexico. What I wrote was to the effect that, while serving at Fort Wingate, New Mexico (1884-89), there was at one time a necessity to send a troop of cavalry into southern New Mexico, and Captain Kendall, of the 6th Cavalry, was detailed to the duty. On the return of that officer, he informed me that one morning, when at some considerable distance north of the Mexican boundary, he was, while laying in his tent, greatly disturbed by the " infernal noise " created by a flock of parrots, that had " great, big bills," and which nearly covered a tree in the immediate vicinity of his camp. This is the only report of the kind that came to me during my entire stay in New Mexico. Captain Kendall knew practically nothing of ornithology, nor had I told him anything about the parrot in question before his leaving, the information coming wholly unsolicited from him upon his return to the Fort. I should have attributed the report to the Captain's having seen a flock of Groove-billed ani *(Crotophaga sulcirostris)* had he not been so positive about their being parrots, with big bills, with green bodies, with red on their heads.

He even testified to the fact that he left his tent and went over to the tree to look at them.

Professor Alfred Newton, F.R.S., in his very excellent *Dictionary of Birds*, concludes his article "Parrot" (pt. iii, p. 691) with the following statement: "Considering the abundance of Parrots both as species and individuals, and their wide extent over the globe, it is surprising how little is known of their habits in a wild state. Even the species with which Englishmen and their descendants have been more in contact than any other has an almost unwritten history, compared with that of many other birds; and, seeing how many are oppressed by and yielding to man's occupation of their ancient haunts, the extirpation of some is certain, and will probably be accomplished before several interesting and some disputed points in their economy have been decided. The experience of small islands only foreshadows what will happen in tracts of greater extent, though there more time is required to produce the same result; but, the result being inevitable, those who are favorably placed for observations should neglect no opportunities of making them ere it be too late."

A number of fine monographs have been devoted to this very thoroughly isolated group of birds, and much has also been written upon their anatomy, habits, and distribution, with schemes for their classification, yet a great deal remains, as Professor Newton remarks, to be said about them.

CHAPTER XIX.

THE UNITED STATES CUCKOOS.

(Family *Cuculidæ*).

CUCKOOS of one kind or another are found in nearly all parts of the world, and, taken as a group, it is one that possesses especial interest for the ornithologist. It is but a fairly well circumscribed family, containing as it does at least a few somewhat aberrant forms. Within the family, cuckoos very widely differ, not only in structure and general appearance, but in their habits of life, nidification, and affinities. If what we know of them were collected together it would make a very large volume indeed; but if on the other hand, could be printed what we do not know about them, quite a good sized library would be the result. Even in the case of the one species, the well-known Old World Cuckoo *(Cuculus canorus)* the learned British ornithologist Newton has said: "No single bird has perhaps so much occupied the attention both of naturalists and of those who are not naturalists, or has had so much written about it, as this, and of no bird perhaps have more idle tales been told. Its strange and, according to the experience of most people, its singular habit of entrusting its offspring to foster-parents is enough to account for much of the interest which has been so long felt in its history; but this habit is shared probably by many of its Old World relatives, as well as in the New World by birds which are not in any near degree related to it,"—as, for example, our Cowbird *(Molothrus)*. In this country we have no cuckoos that are given to the habit of laying or otherwise depositing their eggs in the nests of other birds, unless it be the habit of the Siberian cuckoo to do so, and Bendire has said in regard to this species that as "far as I can learn, nothing definite has as yet been ascertained regarding its nesting habits and eggs. They undoubtedly correspond closely to those of its well-known western relative, the common European Cuckoo, *Cuculus canorus*, and Dr. Stejneger tells me that in its general habits and call notes he could not detect the slightest difference from those of the latter." *(Life Hist., N. A. B., p.* 32, 1895.)

It will be remembered that the Siberian Cuckoo *(C. c. telephonus* [Heine]*)* is, at the best, but a subspecies of *Cuculus cano-*

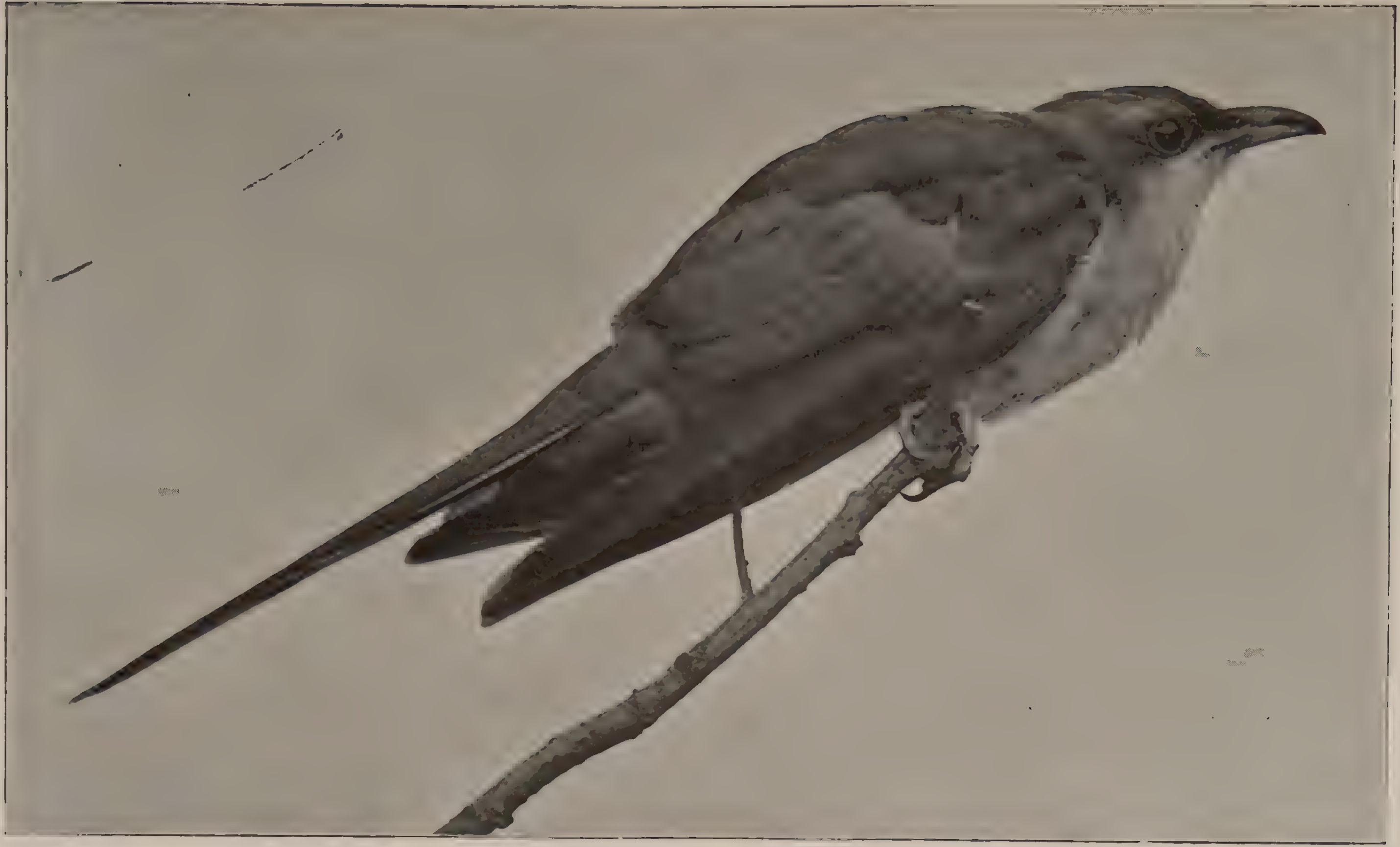

FIG. 64. YELLOW-BILLED CUCKOO (*C. americanus*). Male.

Reproduced from a photograph of the living specimen, made by the Author. (Seven-eighths natural size.)

rus, and has been added to our avifauna upon the strength of a single example taken by Mr. William Palmer at Northeast Point, St. Paul's Island, Alaska, on the fourth of July, 1890. This specimen is now in the collections of the U. S. National Museum. (See *The Auk*, Vol. xi, 1894, p. 325.) The addition of this species of cuckoo to our fauna might be sufficient excuse for me to give an account of some of the habits of its western ally, the common cuckoo of the Old World, but as I have never had the opportunity of studying that species in nature, this would simply result in my culling from the records of others for the purpose; and, rather than do this, I prefer to invite the student's attention to what is doubtless the best brief history of *Cuculus canorus* extant; and I refer to Professor Newton's in his *Dictionary of Birds*, under the title "Cuckoo." (Part I, p. 118.) In connection with this, and in the same excellent work, under the title "Nidification," should be read what Professor Newton has to say in regard to the origin of the practice of certain birds, and among them *Cuculus*, of placing their eggs in the nests of other species, to be incubated by the latter, and the young fostered. Without question, the nearest relatives which *Cuculus canorus* has in this country are the various specific and subspecific representatives of the genus *Coccyzus*. These are the Mangrove cuckoo *(C. minor)*, it having been taken in Louisiana and Florida; Maynard's cuckoo *(C. minor maynardi)*, also having been collected in Florida (Key West); the Yellow-billed cuckoo *(C. americanus)* of Eastern North America; the California cuckoo *(C. a. occidentalis)* of Western North America; and, finally, the Black-billed cuckoo *(C. erythrophthalmus)*, also of Eastern North America.

Personally, I have never enjoyed the opportunity to study more than two of these various forms, namely, the Yellow-billed and the Black-billed cuckoos, but they all are more or less alike in structure, habits, appearance, form, plumage, and some other characters. They all have curved bills; the feathering of the entire head and trunk is soft and blended; the tail and wings are long, giving the whole bird a long and slender appearance; in color they are unstriped, being of a grayish brown above, with a slight bronzy tint to it, while beneath they may be either white, white and buffy gray, or of a deep ochraceous *(C. minor)*. The graduated tail is also tipped with grayish white, save the middle pair of feathers. The feet are zygodactyle—that is, two toes in front and two behind—a character that in the entire history of ornithology in epochs past has been accountable for no end of unnatural classification, and even at the present time is responsible in the schemes of not a few taxonomers for grouping birds together, often otherwise but remotely related. As an example of this in the present family, is the case of the anis *(Crotophaga)* and the Road-runners *(Geococcyx)*, both considered *Cuckoos*, and yet utterly different kinds of birds.

It is probable that the Mangrove cuckoo occurs in this country all along the Gulf coast line from Key West to include Louisiana, being found only in the skirting timber, and never inland. They build a shiftless, flat nest on a horizontal limb, rarely over twelve feet above the ground. The eggs are from three to four; pale green in color, and usually rather larger than those of *C. americanus*, which they are a good deal like. Contrary to the practice of other members of the genus, this Cuckoo, it is said, does not begin to incubate until she has laid her entire clutch of eggs; and, if setting, will defend these latter, much in the same manner as some domestic fowls do—that is, flying at the intruder with ruffled plumage and a clucking note. Although almost entirely an insectivorous species, it likewise has the reputation of sucking the eggs of other birds. Audubon, when at Key West, constantly mistook this well-marked form, "in the course of his walks, for the common yellow-billed species," and did not appreciate the difference until it was pointed out for him by Major Glassel, of the army, who was serving in the fort there at the time.

Maynard's cuckoo is a rather smaller and lighter colored bird than the Mangrove, and thus far in this country has only been taken upon the Island of Key West. In all respects, so far as at present known, this subspecies closely resembles the two eastern North American forms.

One of these latter, our Yellow-billed cuckoo, has a wide distribution all over the eastern part of the country and southern Canada, breeding in suitable localities over the entire range. It is a retiring, secretive bird, and would be but rarely noticed in the tree-tops were it not for its peculiar, often somewhat prolonged gutteral and croaking notes. These are frequently heard just prior to the advent of a shower or storm, and hence the species is known in many places as the "Rain-crow." They are very awkward upon the ground, with their weak feet and short legs, so they rarely alight there. In the air, however, their flight is graceful in the extreme, and often varied, the bird turning a little sideways, and sometimes undulating as it passes with no little swiftness from tree to tree. They always remind me of a slick-dressed Quaker, with a Quaker-gray coat on, and white waistcoat. Most often they hide in the densest part of the foliage, and flit in a quaint way from branch to branch, silently hunting their insect prey. I have had this bird alive a number of times, and several years ago took a fine, large male in the archæological hall of the Smithsonian Institution. One of the attendants and myself kept him flying about till he came down exhausted to the floor. I have also had the young nestlings, just after quitting the nest; they have short tails, big heads, and the lower bill, instead of being of a deep yellow, as in the adults, is of a pale lead blue.

These birds consume simply hundreds of noxious insects, all kinds of caterpillars and worms, and occasionally indulge in some of the small fruits and berries. I have never known of a case where either this species of cuckoo or the Black-billed one was guilty of sucking birds' eggs, and am strongly inclined to discredit all such stories. Were it true, the other small feathered denizens of our forests would surely raise a row every time a cuckoo put in an appearance, just as they now salute a jay. So far as man is concerned, these birds stand among the most valuable of the friends he has to the agriculturist, and fully deserve all the protection he can extend to them.

They are rather late breeders, but in the South may have two broods to the season. Their nests are slovenly, loose, platform-like affairs, composed of short, dry twigs, a few leaves, and a little moss sometimes. In some cases to these may be added pine needles, the catkins of certain trees, and so forth. Many eggs of this bird are destroyed by being blown or otherwise shaken out of their shallow nests; and if one stand below one of them the eggs can often be seen through the flimsy thing. The number of eggs vary from two to five, but sets of six and seven have been taken, and in these latter cases the nest may have been laid in by another female. Sometimes incubation begins after the first egg is laid, but usually the hen completes her clutch ere she commences to hatch. This species occasionally lays in the nest of the Black-billed cuckoo, and *vice versa;* while on the other hand, both species sometimes lay in the nests of other birds, as their eggs have been found in those of the Robin, Mourning dove, Cedar bird and others. These cases, however, are not common, and moreover, the act has been detected among other species of birds, and those remotely affined to the *Cuculidæ*.

In speaking of the species now being considered, Bendire has said: "Incubation, I think, lasts about fourteen days, and I believe the female performs the greater portion of this duty. The young when first hatched are repulsive, black, and greasy-looking creatures, nearly naked, and the sprouting quills only add to their general ugliness. If the eggs are handled the bird frequently forsakes the nest, either throwing them out or abandoning them. The eggs are elliptical oval in shape, about equally obtuse at either end; the shell is close-grained, rather thin, and without gloss. The ground color varies from a uniform Nile blue to pale greenish blue when fresh, fading out in time to a pale greenish yellow. They are unspotted, but occasionally one or two eggs in a set present a sort of mottled appearance, the ground varying somewhat on different parts of the shell. Their color is one of those subtle tints which it is difficult to describe accurately. Many of the eggs resemble in tint some of the lighter-colored Heron's eggs."

In habits and much else the California cuckoo greatly resembles its eastern cousin, and requires no special description here. It is rather a larger bird, with a somewhat heavier and stouter beak. It ranges east as far as the eastern slopes of the Rocky Mountains. Slightly smaller than its conjener, the Yellow-billed cuckoo, the Black-billed species resembles it in most particulars. It is, however, a hardier bird, ranging further north during its migrations in the spring. By the ordinary observer it is often mistaken in the woods for the Yellow-billed, yet the black bill, lesser size, and slightly appreciable difference in its notes are usually sufficient to at once distinguish it in the eyes of the trained ornithologist. "From personal observations," says Bendire, "I am inclined to believe that the Black-billed cuckoo is more irregular in its nesting habits than the Yellow-billed, and that cases of parasitism are of more frequent occurrence. I also think their eggs are much oftener found in different stages of incubation than appears to be the case with the Yellow-billed species." Usually they build a better nest than *C. americanus*, and the two to five (rarely seven) eggs, are considerably darker in color; they are also unspotted. Bendire, in his great work, gives several very interesting accounts of the often erratic nidification of this remarkable cuckoo. Collectors of repute have discovered numbers of pairs nesting together; they have been seen laying their eggs in the nests of other birds; when the clutch is large (5-7) the birds hatch out irregularly often, as the parents commence sitting as soon as one egg is laid; they will lay, as already stated, in the nest of the Yellow-billed cuckoo; they easily desert their nests if any way disturbed, and they have several other eccentricities of this nature. Perhaps one of the most curious instances is that given by Mr. J. L. Davison, of Lockport, New York, who says on "June 17, 1882, I found a Black-billed cuckoo and a Mourning dove sitting on a Robin's nest together. The cuckoo was the first to leave the nest. On securing this I found it contained two eggs of the Cuckoo, two of the Mourning dove, and one Robin's egg. The Robin had not quite finished the nest when the Cuckoo took possession of it and filled it nearly full of rootlets; but the Robin got in and laid one egg. Incubation had commenced in the Robin and Cuckoo eggs, but not in the Mourning dove's eggs. I have the nest and eggs in my collection."

The non-arboreal Road-runner or Chaparral cock *(Geococcyx californianus)* is chiefly found in the southwestern regions of our country, being largely confined to the desert lands, and far less often found in the foothills of the skirting mountain ranges. This bird is a large, handsome Ground cuckoo, of an aberrant type, and evidently affined with other avian groups. Years ago I printed an account of its anatomy in the *Proceedings of the Zoological Society of London;* its osteology in the *Journal of Anatomy*, of Edinburgh, and a colored figure of its head in *The Ibis* (London). In the latter I pointed out the naked skin tract on the back of the head, which during life is of a brilliant scarlet color.

These birds are usually found singly on the prairies, though the half-grown young follow their mother about some time after leaving the nest. This latter, a shallow, flat affair is commonly built on the ground, in low bushes, on cactus plants, or even in small trees, very rarely above sixteen feet from the ground. It is made of small sticks and lightly lined with grass. The unspotted white eggs vary from two to nine in the set, and the bird has a few of the incubatory vagaries of the arboreal cuckoos described above. However, they do not desert their nests when discovered, and the parents are very solicitous of their young. Often I have seen both chicks and adults of this species kept in cages, and they make very interesting and affectionate pets. *Geococcyx* has an easy and swift flight, while on the ground it can for a short distance run and outstrip the fleetest of horses. It has a peculiar call-note, and feeds principally upon insects, lizards, snakes, young birds, etc. Snakes nearly two feet long have been killed and swallowed by them. The stories about the remarkable way in which they pen in rattlesnakes with cactus joints, and then stir up the reptile by dropping a joint on him, which causes it to thrash round till exhausted and is finally killed by the cunning Road-runner, are—to use a fitting phrase—all gammon. It is a cowboy yarn, and paralleled by numbers of others equally mythical, told to comers from the east, in times now nearly past forever.

Still more remarkable among our *Cuculidæ* are the curious cuckoos called Anis; also known in various localities as Black Witches, Savanna Blackbirds, and other names. Two species of these birds are recognized as belonging to our fauna—the Ani *(Crotophaga ani)* and the Groove-billed ani *(C. sulcirostris)*. They are small black forms, each species about a foot long, with the upper bill elevated and much compressed laterally. *C. ani* has been taken in southern Florida and Louisiana, while the other species occurs in the valley of the Rio Grande, Texas, and in Lower California. These are arboreal, gregarious birds of very social disposition. They not only perch close together upon the trees, but a number of individuals build a nest together, and in this several females lay their eggs, to the number of six or eight. Of these Bendire says they "are glaucous-blue in color, and this is overlaid and hidden by a thin, chalky, white deposit; as incubation advances the eggs become more or less scratched, and the blue underneath is then plainly visible in places, giving them a very peculiar appearance." The nest is placed well up in some tree, and is composed of twigs and lined with leaves. Sometimes the eggs are placed in layers with leaves between them, but the eggs of the lower layer have been found to be infertile. Anis are awkward birds both in flight and when in the trees, or upon the ground; they also have a peculiar wail of a cry like a sick kitten; and they also attend upon pasturing cattle after the fashion of our Cowbirds *(Molothrus)*. They feed upon small lizards and eggs of other birds. In fact, the Anis are among the most curious and interesting of any of the cuculine forms known to me, and, some years ago, I studied with especial interest some skeletons of these birds sent me from southern Texas.

Some remarkable and beautiful Cuckoos are found in Africa and the island of Madagascar. The Great Spotted cuckoo of the former country is a very famous bird of this family. Their eggs so closely resemble those of one of the Pies, in the nest of which they are often deposited, that even, as Newton remarks, expert oölogists have been deceived by them, and not discovered which was which until in opening the egg and finding either the embryo Pie or the embryo Cuckoo.

CHAPTER XX.

WOODPECKERS: PHOTOGRAPHICALLY AND PTERYLOGRAPHICALLY CONSIDERED.

(Pici.)

AT different times during the last few years I have pointed out in the pages of various journals some of the advantages to be gained by making good photographic pictures of living birds, and I believe it is safe to say that, at the present time, these advantages are now hardly questioned by any one. We often see in properly taken photographs of birds characters that are never recorded by any other means. My opportunities to make such pictures of living animals of all kinds have never been better than they are to-day, and no chance of the kind is allowed to slip by. By close study of previous failures and experiences, present successes are now of more frequent occurrence, and it is not altogether a rare thing to produce a result worthy of permanent record.

Recently I have been doing something with the woodpeckers, and have been enabled to secure one or two pretty good things. This was my fortune, upon the 21st of last March (1896) and the day following, when I captured alive an adult male specimen of the Downy woodpecker *(Dryobates pubescens)*, and brought him to my studio in excellent condition. He at once gave evidence of being a gentle and the very best kind of subject. It was too late to do anything with him the first day, so he was confined in a cage until next morning, at which time he drank very freely of water with great apparent relish, and, being placed upon a horizontal limb with a shallow, scooped out place on top of it, he rapidly devoured upward of fifty soft larvæ that I put in there before him as his breakfast. His extreme gentleness was remarkable, and he made scarcely any objection to being freely handled, seeming perfectly at home in half an hour after his capture. Owing to his great activity I found it difficult to get a photograph of him upon a horizontal limb, for he betrayed all the restlessness of his genus the moment he was placed upon it in that position. Sometimes he seemed to be upon all sides of it at once, so quick were his movements. Every once in a while he would stop and pound away at the bark, diligently searching for the

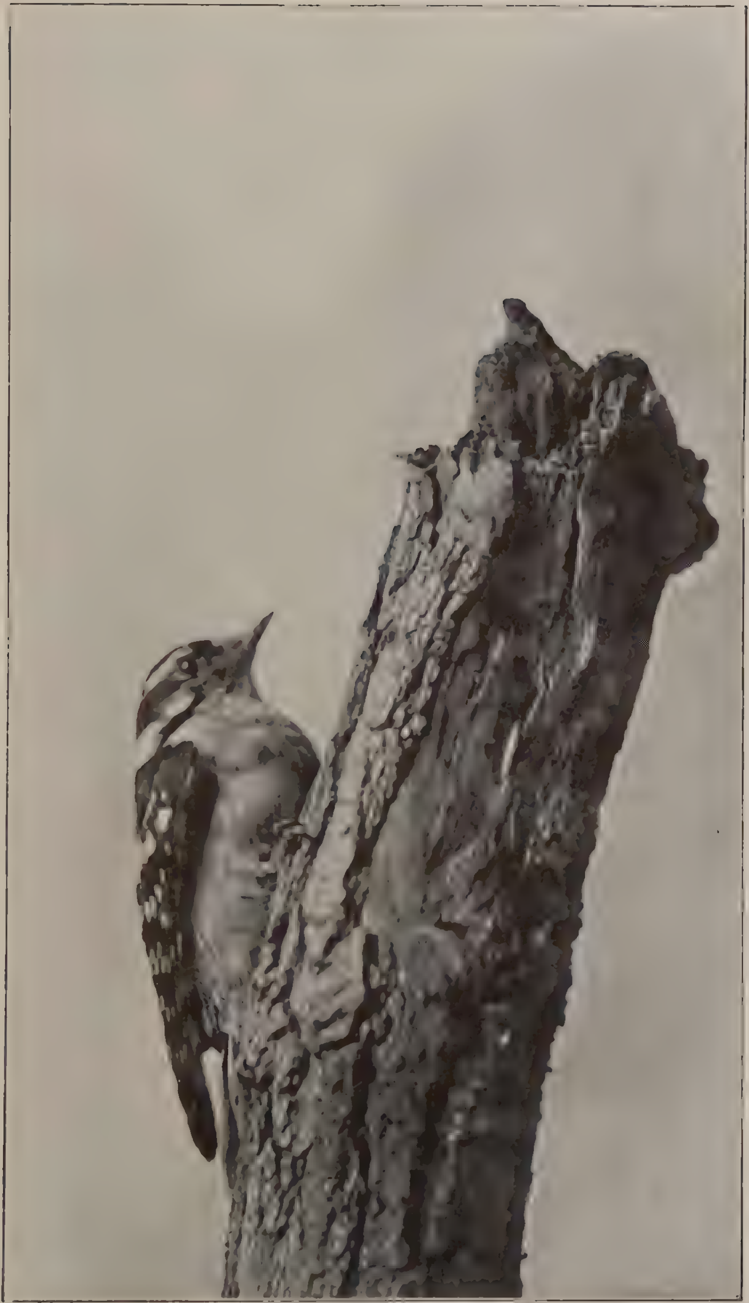

Fig. 65. Photograph of a Live Specimen of Downy Woodpecker (*D. pubescens*); Adult.

Two-thirds natural size. Taken by the Author.

small larvæ that I had concealed in the interstices for him. This would not do, for I had not a particularly good light to work in, and I was using a small " stop," so as to obtain all the detail possible. In order, then, to check his movements a little, it occurred to me to bring his perch to the vertical position. This seemed to make but very little difference to him at first, and he ran up and down the limb and peeped about it, first upon one side, and then upon the other, in a manner most interesting to behold. Several exposures were made upon him, and immediately developed in the dark room near by, but from one cause or another they were not fully satisfactory. At last, however, I got him. He had been playing at hide and seek with me all around his stump, and I had engaged with him at the same game behind the ground glass at the back of my camera, when suddenly he stopped for a couple of seconds, missing me as I hid my head beneath the focussing cloth. The opportunity was too good to be lost, and I squeezed the bulb as long as I dared, and then let go, and the snap of the shutter informed me that he was my woodpecker—at last.

The reproduction of this picture is offered here as an illustration and is shown in Fig. 65. It is one of the best photographs of a living woodpecker that I have thus far met with, inasmuch as it is over two-thirds the size of life; sharp to a fault, and exhibits the bird in a very characteristic attitude. It practically consumed an entire day to obtain this picture, and frequently I have spent a great deal more than that amount of time in securing the result desired. In order to get even as simple a picture as the one here given, it is absolutely necessary that several things be taken into consideration. The operator must possess an intimate knowledge of his subject in a state of nature; he must have taste, and an enormous stock of patience; and finally, in everything only the very best of material must be employed.

Nestlings of a great many species of birds are, at their best, very extraordinary looking objects, but of all these, young woodpeckers are, I think, the most remarkable.

Last May, my son and myself were rambling through the woods of the southern part of Montgomery county, Maryland, within a few miles of Washington. Here, in a great, lofty stump of a limb of an old tree, long dead, he discovered, twenty or more feet above the ground, the entrance to a new nest of the Golden-winged woodpecker *(Colaptes auratus)*. As I was photographing everything living I could lay my hands on in those days, the thought occurred to me that to make a picture of these nestling woodpeckers would be a unique idea. My son, upon climbing the barkless trunk of the dead tree, and examining the nest as well as could be done by listening at the entrance, for it was too deep to reach with the arm and hand, the conclusion was arrived at that the eggs had not as yet been hatched, so we withdrew to await that event.

About a fortnight afterward we returned to the spot, and a second examination convinced us that the nest contained young. By standing on a slippery limb that branched out below the hole of entrance, and by the laborious use of a small hatchet, my boy cut that old tree in two well below the nest, after nearly an hour's constant chopping. Down it toppled with a rush, breaking into several pieces in its fall, but in such manner that we were enabled to carry home the entire portion containing the nest and the young.

There were seven of these latter, and, as I have said, they were surely the oddest looking creatures alive. They varied somewhat in point of size and in gradation, the smallest one being not more than two-thirds the size of the biggest fellow, which I took to be a male. They were a lively flesh-color in hue, and featherless, all to the pinfeathers of the feather tracts, which, by the way, showed the woodpecker pattern most beautifully, being full of interest to the pterylographist, or to the one who describes the different feather tracts upon the bodies of birds. Their eyes had not as yet opened, and their necks were long and snake-like, and none too strong to balance their big heads. Another very remarkable feature was the chalky, hard, knob-like growth at either angle of the mouth, and I am quite unable to say anything about the origin of this protuberance, or its use; it is well known, of course, that it gradually disappears as the birds grow, and in the fully feathered nestling it has about all disappeared.

This brood was placed in a suitable box, half full of dry sawdust, and the entire lot huddled together down in one of the corners. Assuredly to the eye they presented a curious, tangled mass, that kept up a continuous shivering motion, accompanied by an unharmonious baby-picine snoring, low in pitch, peculiar in nature, and that could be heard for some little distance from the box.

Upon the slightest disturbance in their neighborhood, each

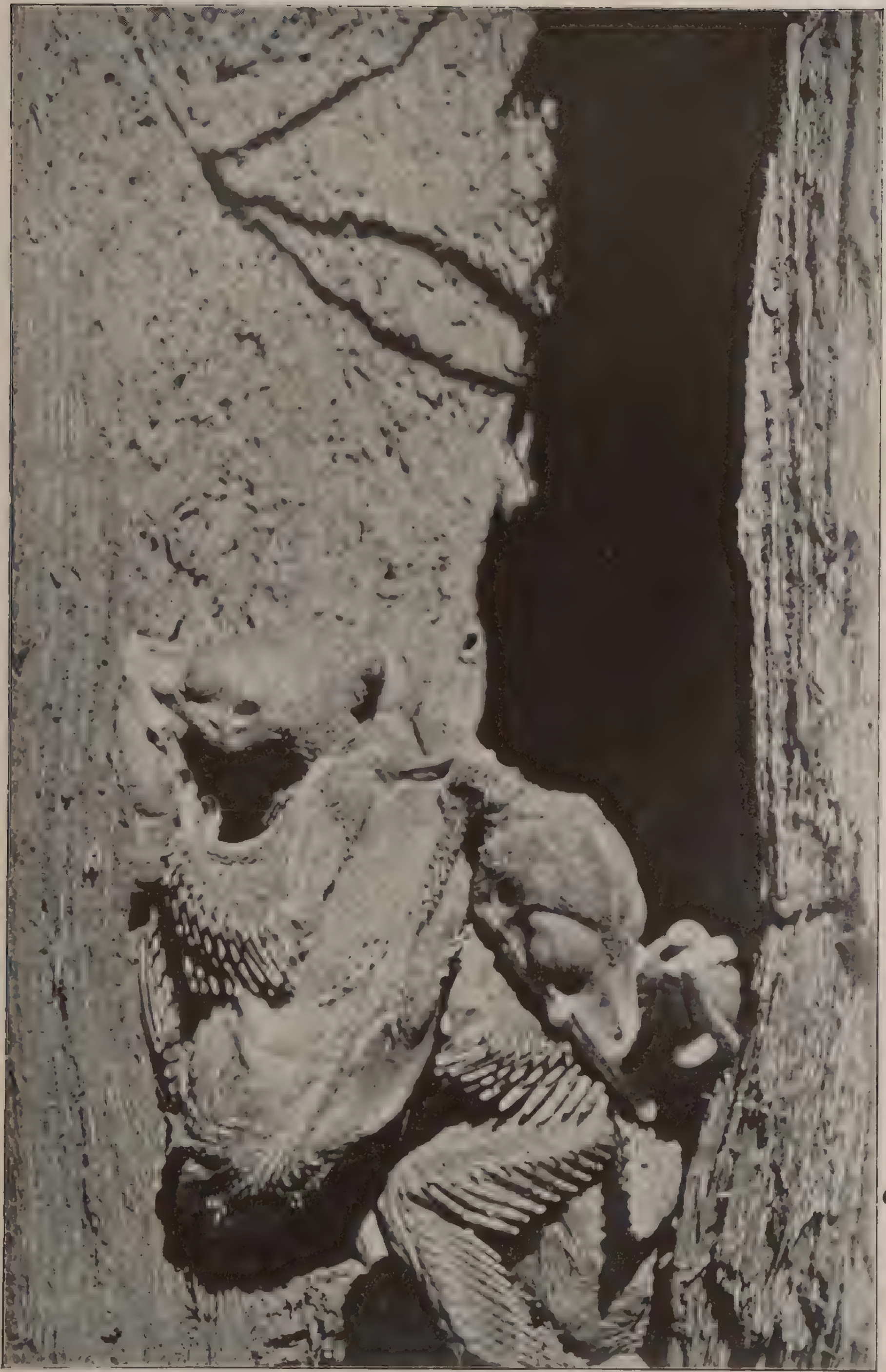

FIG. 66. VERTICAL SECTION OF TREE SHOWING NEST OF GOLDEN-WINGED WOODPECKER, CONTAINING SIX YOUNG.

bird at once disengaged itself, and with an awkward, quivering stagger, arose as best it could, semi-erect, and stretching out its neck to its utmost capacity, gave vent to a grunting, hissing, noisy quaver that, when added to the voices of the other six, could be heard only too distinctly all over the house. At this time all their mouths gaped wide open, and they relished both water dropped into them, as well as a bolus of bird food, big enough in each case for a half-grown chicken. A moment or so after the source of their alarm was withdrawn they gradually settled back into their former huddled mass, and with equal deliberation lowered their voices to again resume the low snoring sounds above described. It was surprising how little it took to arouse them; one might hold over the group the expanded hand, at the distance of a foot or more away, and then, by an up and down gentle movement, so as to fan the bunch in the very slightest degree imaginable, they would at once arise *en masse*, and create the same unearthly disturbance I have already attempted to describe. There is no question but that the least breath from a parent's wing at the nest's entrance would be ample to thus excite this strange crew; and I suppose this has been brought about from the fact that they have nothing else to do but lie there and await being fed, with all their mental armament concentrated upon listening for the coming of the old bird with the juicy larvæ. As there seemed to be no end to their appetites, I'll warrant the old ones are kept busy to supply their hungry maws, and are pretty tired by the time nightfall comes round.

One thing about these young woodpeckers struck me as very peculiar, and that was the remarkable size of the excrementitious mass any one of them passed at a time, as well as the fact that it seemed to require the action of the whole body to accomplish the feat—and no wonder. On every occasion, in nature, this is at once removed from the nest by a parent bird, who carries it out and drops it at some little distance.

In cutting this nest, I believe the birds had simply very slightly enlarged the hollow heart already destroyed by rot, and carried their work down for about two feet. Below this point for several feet the tree was likewise hollow, and the strange part of it was, that the bottom of the nest was composed of sawdust not very strongly stuck together, but strong enough to compose a partition a little over an inch thick, that horizontally and completely divided off the nest part from the continued hollow of the tree below it. On the upper side of this partition the seven young "flickers," or "high holes," as they call them in New England, had been hatched.

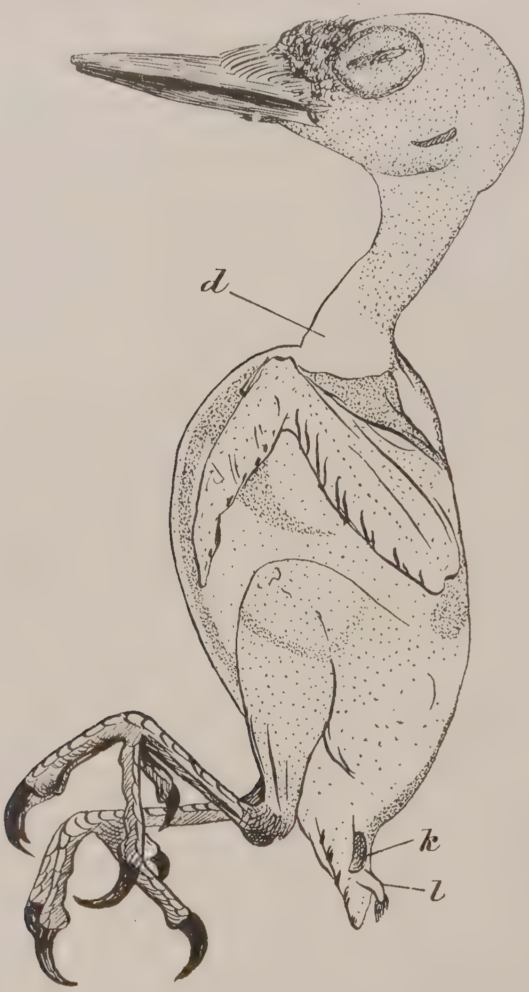

FIG. 68. PTERYLOSIS OF HARRIS'S WOODPECKER.

Left lateral view of a plucked specimen of Harris's woodpecker (*D. v. harrisii*); adult male; *d*, upper part of the "inferior space" (*Apt. mesogastræi*; *k*, the uropygial gland of the left side; *l*, its external papilla with opening at its summit, which is also "tufted."

On May 31, 1896, I vertically divided this nest directly through its median plane, and placing it in a favorable position for light, and allowing six of these young birds to settle down in normal

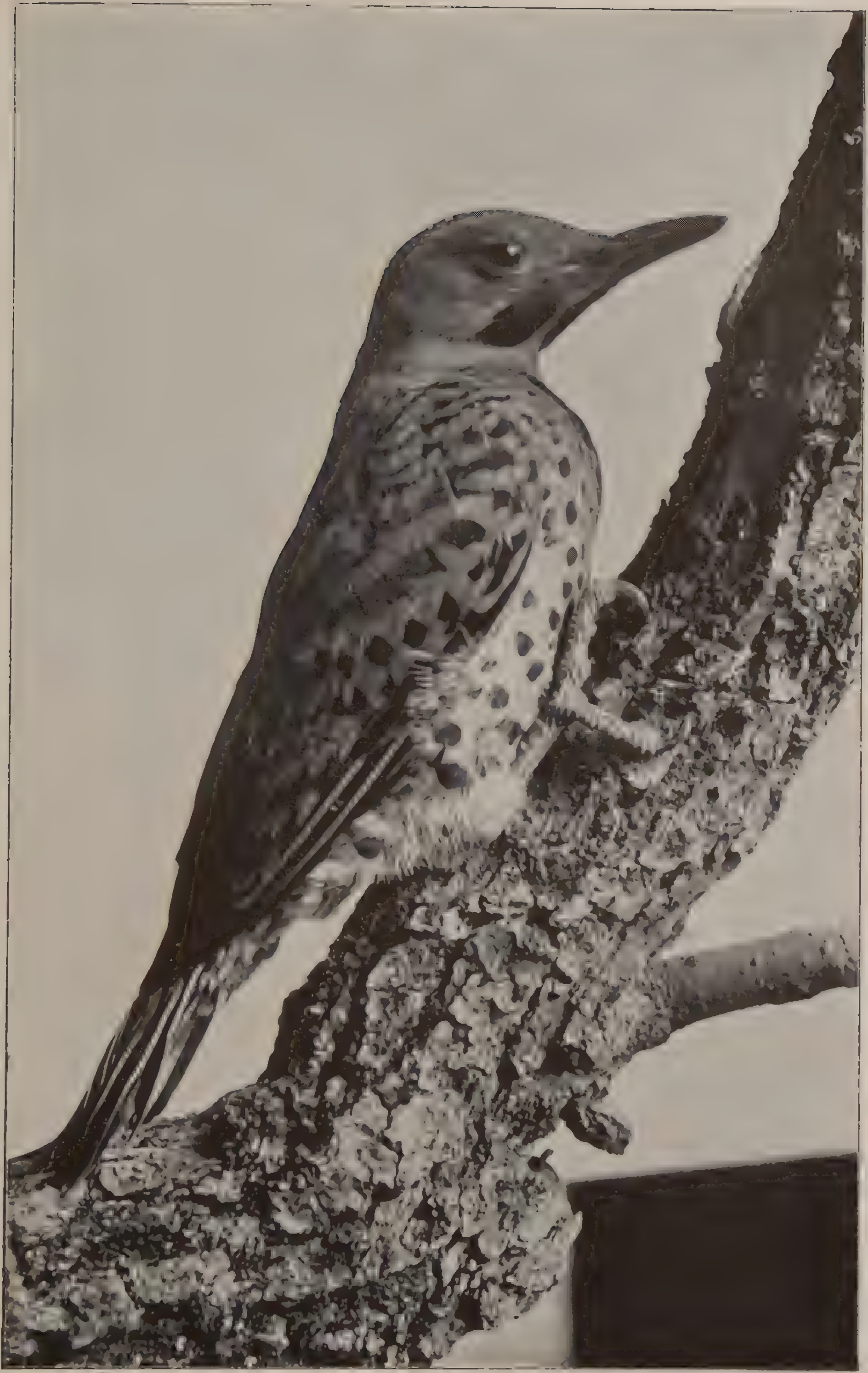

FIG. 67. NESTLING GOLDEN-WINGED WOODPECKER.

Nearly life-size. From a Photograph from life by the Author.

attitudes on the shelf bottom of their former home, I made the photograph, a copy of which appears as one of the accompanying illustrations. The birds shown in this picture I take to be about ten or twelve days old, and it must be several days after this before any feathers begin to appear upon them.

Later in the season my son found another nest of this species, and from it succeeded in capturing a nestling that was just about to shift for itself. Of this bird I succeeded in getting a number of good photographs, and one of these is reproduced here, exhibiting him in a peculiar attitude that he assumed when he jumped from the horizontal part of a limb to another portion growing out from it at nearly right angles. Coming to a rest after this jump, he frequently held on to the bark with his foot in the awkward manner illustrated in the picture shown on this page.

In closing this chapter I desire to say a few words about the pterylography of woodpeckers, and were the question propounded to any person who had never given the matter a thought—are the feathers of birds implanted in their skin in such a way as to spring from it by an even and unbroken distribution over the entire surface of the body, or are the feathers arranged upon any plan, so that were they all trimmed down close to the skin there would be presented to us some definite pattern of arrangement duly outlined by the remaining extremities of the quill-butts? I am inclined to suspect that not only that person but perhaps a great many people would at first say, "Why, a bird's body is entirely covered with feathers, of course, and they arise by an even distribution all over it." Now, the truth of the matter is that there are but a very few birds indeed that at all approach any such condition (penguins, toucans, and ostrich-like birds), the vast majority of the class having their feathers arranged upon their bodies after some definite plan. This particular arrangement of a bird's plumage is technially designated by those engaged in investigating their structure as its pterylosis. From the several parts of the body the feathers spring from the skin along certain lines, or from definite circumscribed areas, in either case known as "tracts" *(pterylæ)*, while the unfeathered portions which occur in between these are defined as "spaces" *(apteria)*. Such being the case, science in due time seized upon this discovery and enlisted so useful a character as an aid to the classification of birds, as men were not long in finding out that the pterylosis differed in the several families and orders of the class. A great continental naturalist, Nitzsch, has done more for us in this direction than any one else, and I may add that the pterylosis of a great many of our United States birds remains yet to be described, and that, too, in many important forms demanding a more correct classification than has thus far been awarded them. Further on I will demonstrate this latter statement by an example, and as the pterylosis of a bird with due care can easily be described and worked out, it is the chief object of this part of the present chapter to excite the interest of naturalists and others in this subject, with the hope that further investigation in the field will be duly undertaken.

Nitzsch employed four principal methods of studying the pterylosis of a bird: (1) by examining nestlings; (2) by plucking adult specimens; (3) by clipping off all the feathers, wetting the body, and then examining it; and (4) by skinning the bird, and studying the *pterylæ* and *apteria* upon the inner surface of the skin.

In the present connection it is not the writer's intention to enter upon the subject of the study of the structure of the numerous forms that feathers themselves are known to assume, for as interesting as this is, space alone would prevent such a step here. Nor do I intend to dwell, and for the same reason, for any length upon the arrangement or number of the feathers-in-chief of the wings *(remiges)* or the tail *(rectrices)*, both of which are known to be so various in birds. Much less do I intend to enter upon the character of plumage itself, and the fantastic variations it may display in a great many of the representatives of the Class.

On the other hand, I shall aim to present the several names which have been bestowed upon the feather-tracts, to designate them; and by pointing them out by the aid of my drawings, herewith presented, show their relative position in one of our birds; and finally will offer another bird, nearly related, and with appropriate figures endeavor to point out the value of pterylosis in classification.

By this means I hope to lay a safe guide before any one, who in the future may have the opportunity to study the pterylosis of our birds, and especially in those forms which, up to the present writing, have not fallen into the hands of science except in dried skins, which are useless for such purposes.

Any *accurately* recorded pterylographical notes are of the highest importance to the science of ornithology.

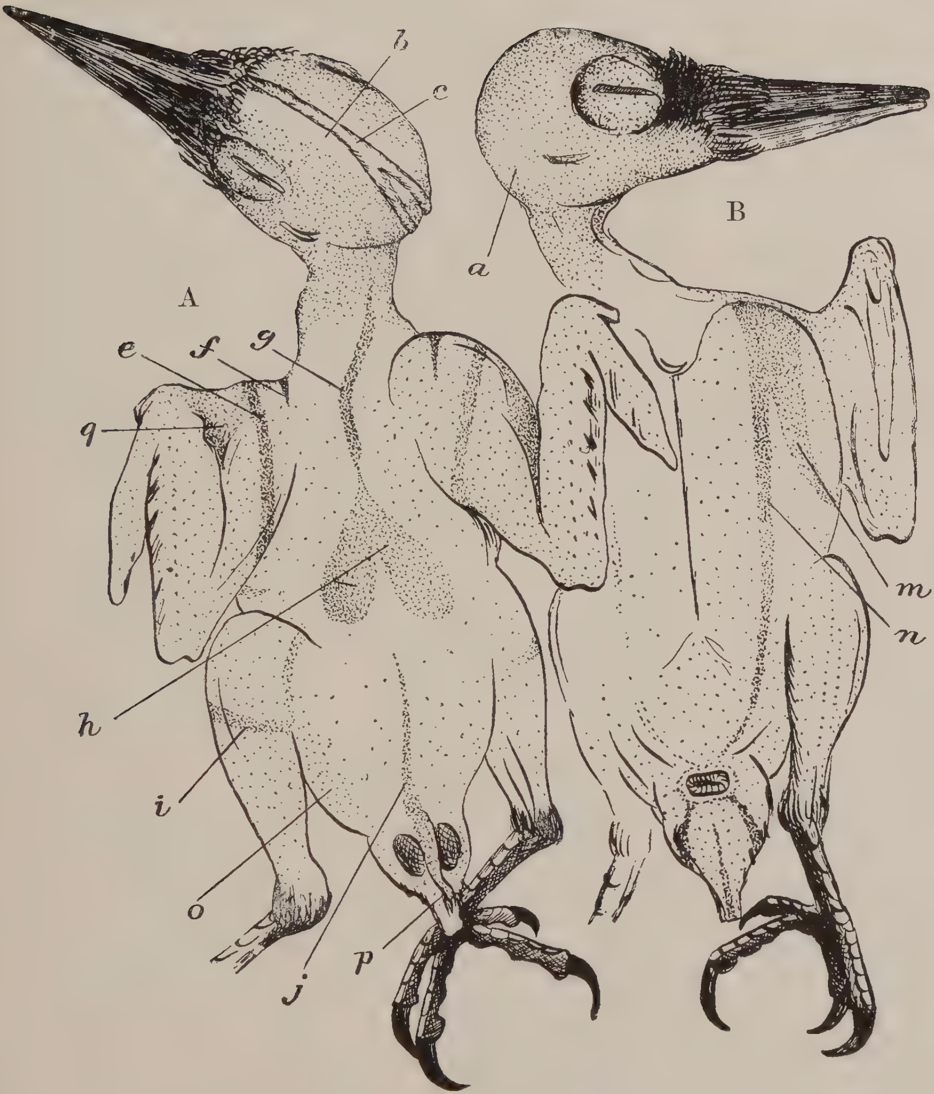

FIG. 69. PTERYLOSIS OF HARRIS'S WOODPECKER.

A. Dorsal aspect of the same specimen shown in Fig. 68; *b*, capital apterium; *c*, the median (at the point indicated) elevation of the skin caused by the epibranchials of the hyoidean apparatus beneath it; *g*, spinal tract; *f*, inner humeral tract; *e*, humeral tract; *h*, lower dilation of spinal tract (the saddle); *j*, lower part of spinal tract (rump tract); *i*, crural tract; *o*, femoral tract (very faintly seen in a woodpecker); *p*, caudal tract; *q*, alar tract. B. Anterior or ventral aspect of the same specimen, with its head turned to the left; *a*, capital tract; *n*, the ventral tract, and *m*, its external branch. All the figures drawn by the Author from the specimen.

Let us next investigate this matter in the way I have already proposed above, and for this purpose I choose an adult male specimen of Harris's woodpecker *(Dryobates villosus harrisii)*

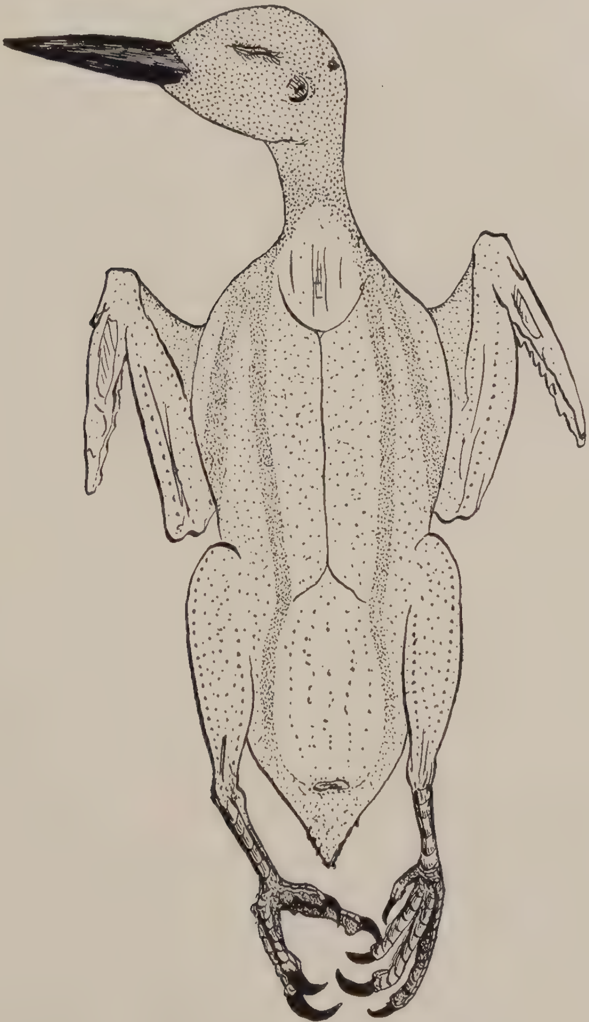

FIG. 70. VENTRAL VIEW OF A PLUCKED SPECIMEN OF THE RED-NAPED WOODPECKER (*Sphyrapicus v. nuchalis*).

Showing its pterylosis or feather-tracts. Life size, by the Author, from nature.

and an adult male specimen of the Red-naped woodpecker *(Sphyrapicus varius nuchalis)*. These birds are now before me;

and first we will pluck them both carefully, commencing at the base of the mandibles in each case, and extending it down as far as the root of the neck.

It will at once be observed that in these two woodpeckers the head-tract or capital pteryla *(P. capitis)* is very different. In Harris's woodpecker there is a median naked space on top, for the most part overlying the elevation caused by the epibranchials of the hyoidean arches, which Nitzsch says occurs in all the woodpeckers he ever examined, but this authority never inspected a specimen of our *Sphyrapicus*, and in this bird the head is completely covered with feathers (Figs. 70 and 71), and no such median naked space is to be found. Another apterium, also described by Nitzsch, occurs on the sides of the head in the temporal space. I find this in *Dryobates* and *Colaptes*, and it may be present in *Sphyrapicus*. Moreover, as *Sphyrapicus* has a hyoidean apparatus very much as we find it in the majority of birds where the epibranchials are not curled over the top of the skull as shown in Fig. 69 at *c*, the skin is not elevated along that region. In some birds, of course, as the condors, the head is destitute of feathers. The head-tract, as a rule, however, includes the head and the lateral tracts of the neck, merging below into the *ventral* and *spinal* tracts (Figs. 68 and 69). We may next completely finish the plucking of our two specimens, closely observing the position of the feathers as we deliberately remove them. Now it will be found that with some few birds, very few comparatively, a strip of feathers of uniform width runs down the entire length of the back, but as a rule the greatest amount of variation exists in this particular. In the case of the two woodpeckers before us a marked difference is again seen, for this spinal-tract in Harris's woodpecker commences above as a narrow, median, longitudinal strip, which dilates at the middle of the back as a bifurcated "saddle-tract" (Fig. 69, *g* and *h*); then occurs an interruption when a rump division of the spinal-tract commences and extends down over the tufted oil-gland *(j)*, while that part which is carried over the caudal region (the true tail of a bird) is designated as the CAUDAL-TRACT. Turning to *Sphyrapicus* we note that there is no interruption in the spinal-tract, and that the "saddle portion" is a lozenge-shaped area, as shown in Fig. 71. This is particularly interesting when taken in connection with the condition of the hyoid in this bird, for the arrangement is quite similar to the spinal-tract as it is found in passerine birds generally.

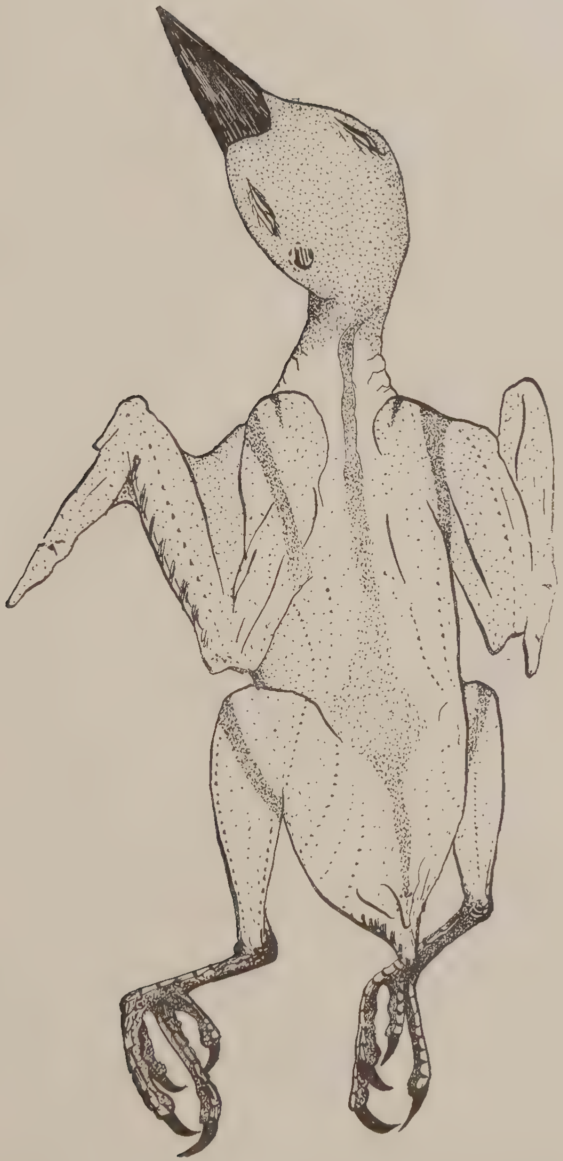

FIG. 71. DORSAL ASPECT OF THE SAME SPECIMEN OF *Sphyrapicus*.
SHOWN IN FIG. 70, DESIGNED TO ILLUSTRATE ITS PTERYLOSIS.
Life size, by the Author.

Birds also exhibit a great variation in their spinal tracts, and I trust some of the readers of this chapter will demonstrate this to their own satisfaction.

Still referring to Figure 69, we note that the humeral region of each arm is obliquely crossed by a narrow feather strip *(e)*, which is known as the *humeral-tract* (the single long bone of the arm is the humerus), while in our woodpeckers we see a character quite peculiar to them, being present in both of our specimens, and shown at *f*, a little separate tract, called the *inner humeral-tract.* Nitzsch found only one woodpecker that lacked this characteristic feature, a Sumatran type *(P. luridus)*. Such feathering as a wing may show, aside from the flight feathers, is collectively spoken of as the ALAR TRACT (Fig. 69, *q*).

Over the region of the thigh there is a tract known as the FEMORAL TRACT (Fig. 69, *o*), which is but very faintly indicated in woodpeckers, not noticeable at all in most specimens and species.

Then across the leg there is a well defined strip which we call the CRURAL TRACT, shown in Fig. 69 at *i*, and is even more conspicuously seen in *Sphyrapicus* (Fig. 71).

We may also see from these figures that the *apteria*, or naked spaces, are sparsely covered over in some places by small, downy feathers of an elementary character.

Turning next to Figures 69 B and 70, we are enabled to study the feather tracts as they are found to occur upon the ventral aspect of the body—and here again we note that no little difference obtains between our two specimens of woodpeckers.

Most often the VENTRAL TRACT is a single broad one, extending from the region of the shoulder in front down to the vent, being situated about half way between the middle line of the body and the side, and not so well marked for its lower moiety as it is above (Fig. 69 B, *m* and *n*). In these woodpeckers, however, the upper part of this ventral-tract bifurcates, giving rise to an external tract seen at *m* and of quite a different form in *Dryobates* and *Sphyrapicus.*

A circlet of feathers usually surrounds the vent, and in Harris's Woodpecker there extends down over the anterior aspect of the coccygeal region, from this point, on either side, a narrow feather tract, which, taken in connection with the median line over the same part, we might collectively name the POSTVENTRAL TRACT, in the absence of any other designation known to me for it.

We have, then, the following feather tracts to study and compare in birds with the view of assisting us in our classification of this group of vertebrates, viz.:

1. The spinal tract *(Pteryla spinalis)*.
2. The humeral tract *(Pteryla humeralis)*.
3. The femoral or lumbar tract *(Pteryla femoralis seu lumbalis)*.
4. The ventral tract *(Pteryla gastrœi)*.
5. The lateral neck tract *(Pteryla colli lateralis)*.
6. The head tract *(Pteryla capitis)*.
7. The wing tract *(Pteryla alaris)*.
8. The crural tract *(Pteryla cruralis)*.
9. The caudal tract *(Pteryla caudalis)*.
10. The postventral tract *(Pteryla postventralis)*.

There will, too, of course, be some anomalies to be on the lookout for, as we see in the "internal humeral tract" and such others like it.

This chapter will not have been contributed in vain if it but prove to be the means of inciting even one careful observer to enter upon this very fruitful field of research.

As for myself, I was never so fully impressed with the value of pterylography as an aid to correct taxonomy in birds as I was when I came to investigate this character and compare it in the swifts and humming birds, forms by many supposed to be related to each other closely enough at least to place them in the same order. I found the pterylosis in a swift very different from the pterylosis in a humming bird, a fact which further supports a former suggestion of mine, elsewhere published, to the effect that these birds be placed in entirely different groups.

CHAPTER XXI.

THE CEDAR BIRDS: WITH NOTES ON WHERE BIRDS LAY THEIR EGGS.

(Ampelidæ, Turdus, Vireo, etc.)

MANY of our birds are far better known to people at large than are others. As, for example, bluejays, robins, catbirds, wrens, crows, bluebirds, and the like, are recognized upon sight by almost any one—certainly by any intelligent person; but this is by no means the case when such forms as vireos, kinglets, pipits, leucostictes, blue-headed euphonias, and others come to be considered.

Cedar birds most emphatically belong to the first class mentioned, and the graceful form of this species and its exquisitely delicate plumage are so well known that neither require any detailed description here. As I write, I have before me twenty-one beautiful skins of cedar birds belonging to my son's private collection. They were all taken by ourselves last summer, near Washington, D. C., and prepared by him. Both sexes are fully represented, as well as the young, and the series as a whole exhibits various plumage phases. There are also before me many photographs of cedar birds taken by myself last spring and summer, from living specimens that we captured. One of these latter, a fine adult male, I likewise possess at this time, he having been kept as a cage bird by me for nearly six months. At present (October 10) he is in molt, and the process in this species is most interesting to observe and study. Figs. 72 and 73, here shown, are reproduced from photographs I made of this bird when he was in full plumage, while in Fig. 74 we have him again, in company with a female which I had alive at that time.

These birds tame very easily, and are quite as easily kept. They are passionately fond of a variety of berries, as any of the small garden fruits, as they likewise are of gumberries, pokeberries, and cedarberries. In nature, when these latter are ripe, the cedar birds flock to the trees, often in considerable numbers, to feed, and owing to this circumstance it has received one of its names. Although its plumage in confinement seems to be kept in the very neatest possible trim, I have never seen the bird bathe; yet they are very fond of having their cage placed out so they may gain the advantage of a gentle shower.

This specimen of mine is very dainty about his plumage, and when hopping across the floor of his cage to reach his drinking-cup, he goes by short leaps, holding his tail erect in a very peculiar manner. As is well known, they have no true note, and it is only occasionally, in a cage, that they give vent to their characteristic shrillish lisp, that may be easily heard and quickly recognized at some little distance away. He is very fond of sitting quietly on his perch, and fluffing himself up to enjoy a sun bath; at which time he slowly erects and lowers his beautiful crest, occasionally uttering a low lisp, with the intention of calling such others of his species as may be in the neighborhood.

Cedar birds are distributed over North America at large, and are known in various localities by different names. They are widely known, for example, as Cedar Waxwings, or simply Waxwings, from the peculiar growths found upon the terminal ends of the shafts of the secondary feathers of the wings, and frequently ornamenting the tail feathers in a similar manner. On a wing these appear like small, graduated, elongated scales of red sealing wax, but really are a modification and development of the feather shaft. By some they are supposed to protect the ends of the secondaries when the bird is fluttering in the dense foliage of the cedar trees after its food; but I am of the opinion that they serve no such purpose whatever, being merely ornamental in character. They vary in number from a few to nine, and on the tail they may be minute, or as large as the largest on the wings. Some ornithologists state that they sometimes occur on the primaries of the wings, or even on the inferior tail coverts, but I believe the statement to be erroneous. Both sexes possess them, but they are of more frequent occurrence on the males. During the molt these appendages develop within the "pin-feather," and are of full size when the latter bursts and the feather makes its appearance. In young birds of the first year, if they are present at all, they are white and very minute.

We have another bird of this genus in our avifauna, and indeed it is distributed over the northern parts of the entire northern hemisphere. This species is the Bohemian Waxwing (*Ampelis garrulus*), and though a good deal like our cedar bird in appearance, is a much larger form, with white upon its wings, and with some other differences in its plumage. *Ampelis phœnicopterus*, of southeastern Siberia and Japan, is a Waxwing that resembles the Bohemian, but instead of the yellow tips to the feathers of the

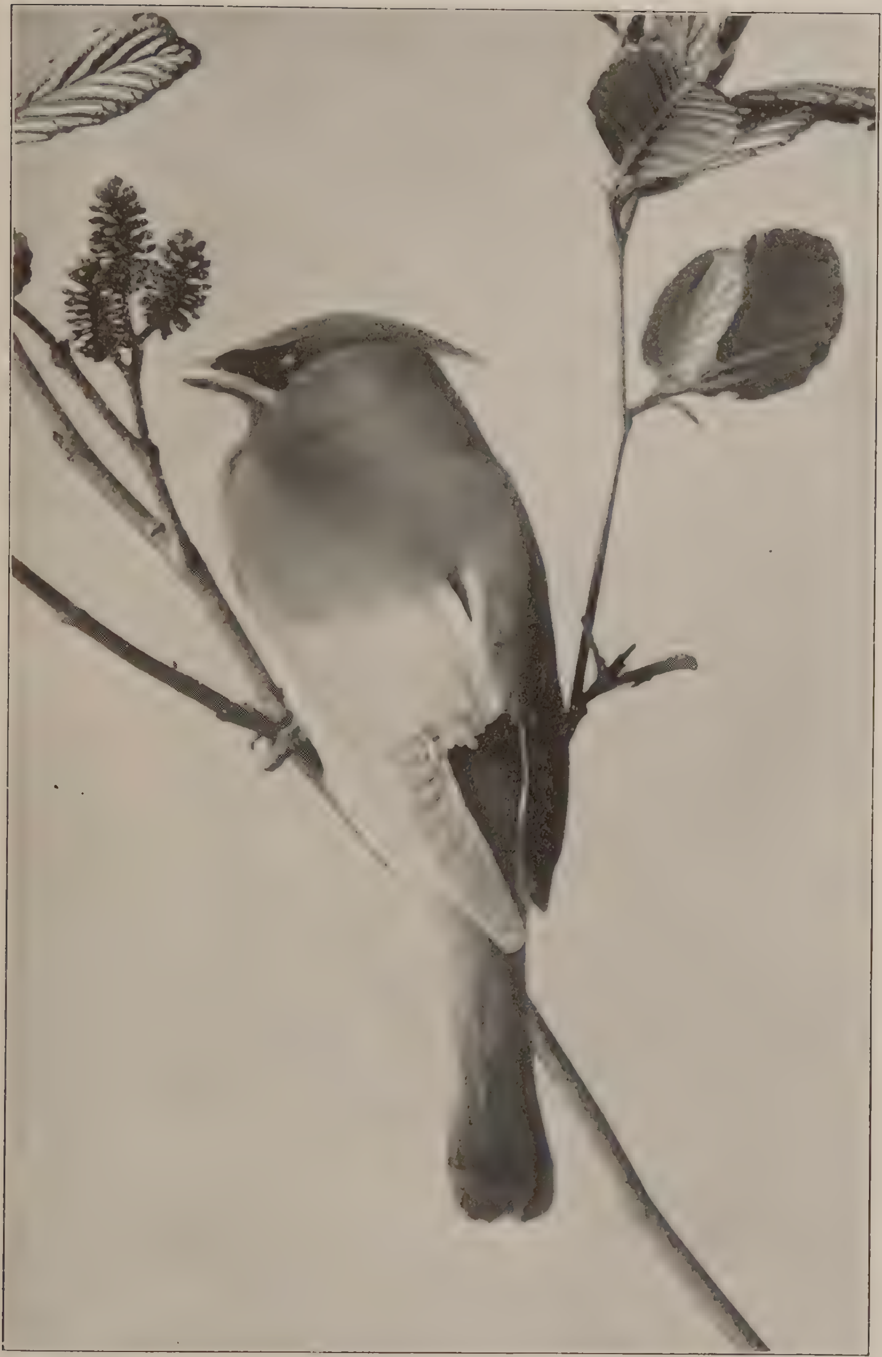

FIG. 72. CEDAR WAXWING (*Ampelis cedrorum*).

Photograph from life.

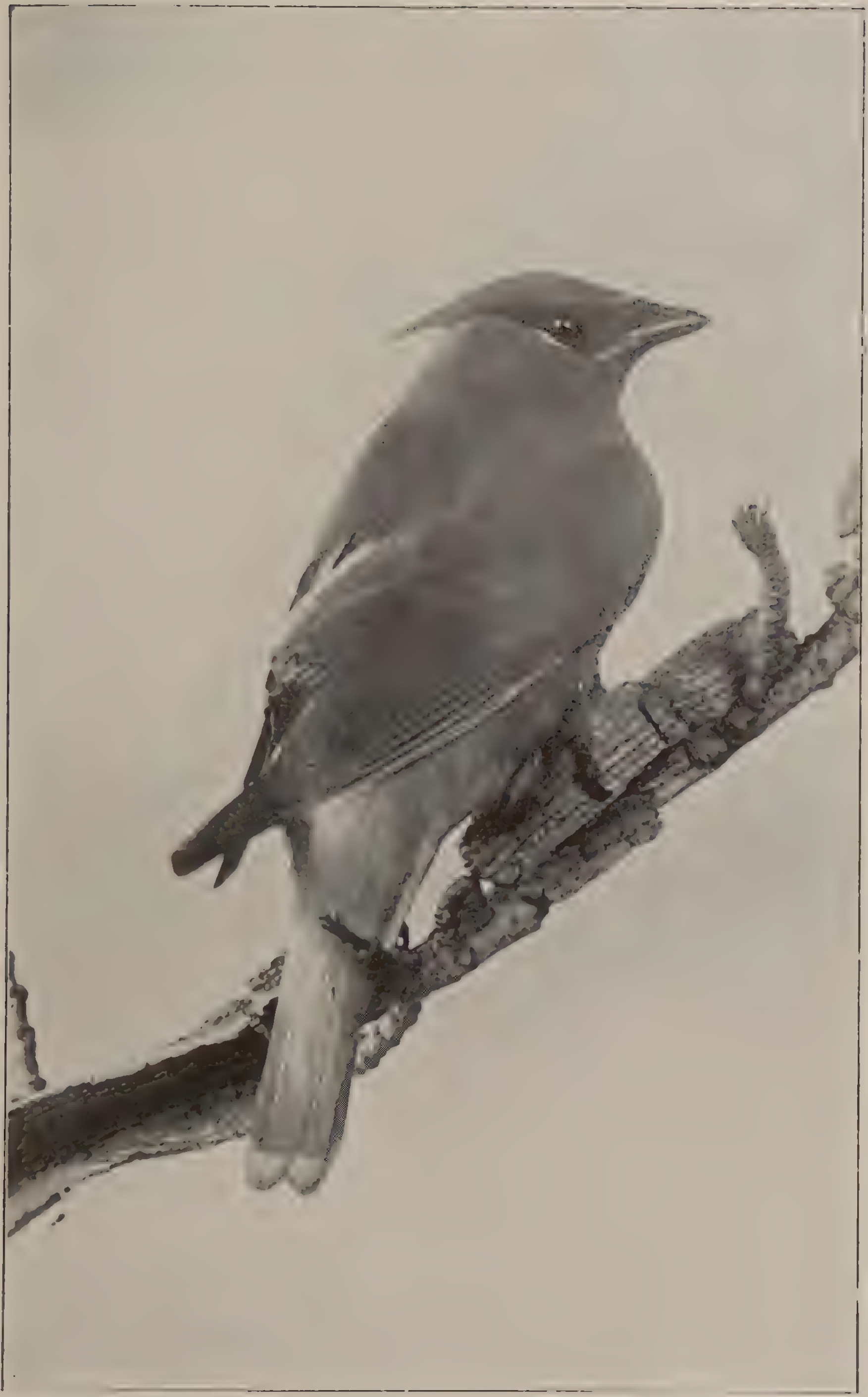

FIG. 73. CEDAR BIRD (*Ampelis cedrorum*).

Ad. ♂ Life size, from living specimen. From a photograph by the Author.

tail and wings, they are red, and the waxy ornaments are absent.

Cedar birds are also known as cherry birds in some localities, and in other parts as chatterers; this latter name being totally unmerited, as we have but few birds so silent by nature, being almost devoid of either note or song. They say the Cedar bird has lost the desire to sing from the fact that owing to its voracious appetite for berries, and its throat being constantly choked with them, no time can be given to any such accomplishment.

The name chatterer came first to be applied to the Bohemian Waxwing from a misinterpretation of the word *garrulus*, the specific term of its name. In certain parts of Europe the cinnamon-brown of the Waxwing was a reminder of the somewhat similar color of their Jay *(Garrulus glandarius)*, a very garrulous bird, to be sure, and a chatterer by nature. Waxwings are crested like Jays, hence its specific name, and hence, too, the confusion and mistranslation and application of its real English meaning. When grouped together the Waxwings constitute the family *Ampelidæ*, and they probably see their nearest allies in this country in our Phainopepla *(Phainopepla nitens)*, of the southwestern parts of the United States. Bohemian Waxwings—found in northern United States in winter—are extremely erratic birds in their migrations, often visiting certain localities suddenly and in vast numbers. Thirty-five years ago Kennicott found it breeding on the Yukon, in Alaska.

Toward the middle of June the Cedar birds disperse over the country in pairs to breed. They usually build in cedar, chestnut, or orchard trees, a somewhat bulky nest, placed in a fork from ten to thirty feet from the ground. They lay some three or four beautiful bluish white eggs, which are handsomely marked, and the young are hatched on or about the first of July. These latter are peculiar little fellows with spotted or coarsely streaked breasts, and they have a habit of sitting bolt upright, with their heads and necks stretched out to their utmost lengths in a line with the axis of their bodies. While thus posed—and the adults are likewise given to this habit—they are perfectly motionless and silent. I have fine photographs of both old and young while assuming this attitude. Parent cedar birds first feed their young upon insects and larvæ, but as the latter grow, upon various kinds of berries.

Often near eventide, I have noticed a small flock of Cedar birds in the limbs of some tall, isolated tree, while ever and anon, first one individual and then another, or even perhaps two or three at a time, will launch listlessly off their perches, and sail silently and obliquely upward into the air, to capture insects upon the wing that they may observe from a few to some fifteen or twenty feet or more from the tree occupied by the flock. This practice they will keep up for an hour or more, and the sight is a very interesting one to the beholder.

Comparatively speaking, we find but few nests of the Cedar bird, owing to the muteness of the species and its habit of flying away upon the slightest alarm and at a distance watching the intruder. The latter may even examine either eggs or young without the parents coming near, much less exhibiting any concern or distress.

Frequently in the fall and winter these birds are shot for the market and the table. At this season they are often very fat, and quite as palatable as a Reed bird. They usually fly in dense flocks, and the present writer has killed as many as fifty or sixty at a discharge of a double-barrel gun.

Wilson, who has written one of the most truthful accounts of the Cedar bird that I have ever had the pleasure of reading, says this "species is also found in Canada, where it is called Recollect, probably, as Dr. Latham supposes, from the color and appearance of its crest resembling the hood of an order of friars of that denomination." It may be also said here that the species bears a variety of different names throughout Mexico, Central America, and the West Indies, in the parts of those countries where the bird is distributed.

Speaking of the nidification of the cedar birds reminds me of the homes that other of our feathered favorites build for themselves, and among these I recall the nest that the Wood Thrush builds, and, one afternoon last summer, as the lovely month of May was drawing to a close, I had rambled a half mile or more away from my home, over the low hills of southern Maryland, to a spot where a pair of whip-poor-wills had been observed the evening before, and where I was led to believe their eggs might be found.

The air was balmy to a fault, and the piece of woods I was in, radiant and lovely with all that makes the budding summer so charming. Chestnuts, maples, gums, and many other beautiful trees were in full and delicate leaf, while beneath my feet the

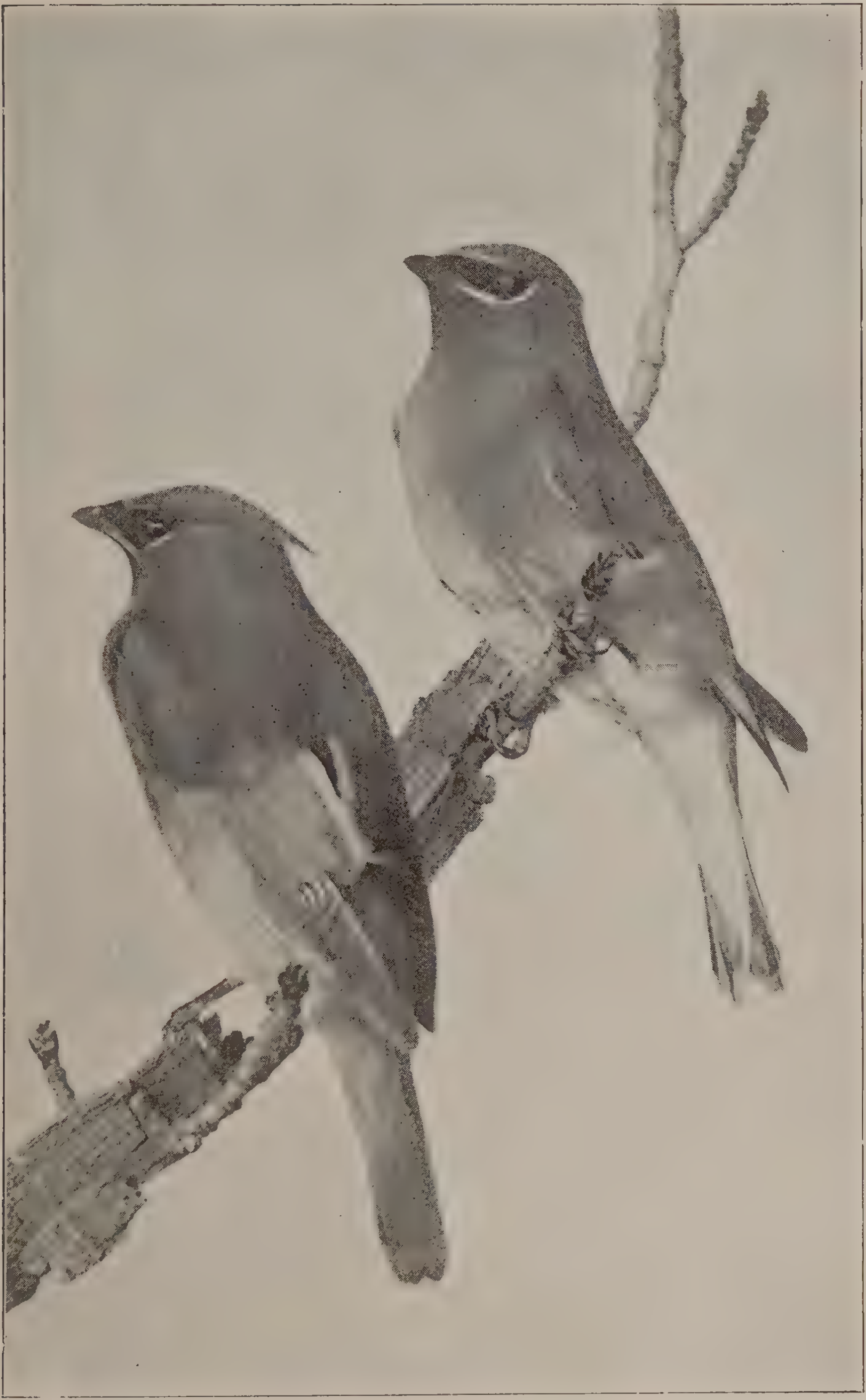

Fig. 74. A Pair of Cedar Birds. Ad. ♂ and ♀

(Lower figure male.) Reduced one-third. From photograph of living specimens by the Author.

ground was carpeted with an hundred and one plants or mosses, and other " things that growin the woods," upon which it seemed almost a sacrilege to step, or crush beneath one's feet.

Hope of finding the object of my search had been abandoned, although the female bird had been flushed. In turning to retrace my steps homeward, I chanced to peer among the trees that timbered a considerable hollow directly below where I stood. The sun poured its generous rays down in there, and the new, fresh leaves of the half-grown maples appeared almost a livid green, as, motionless, they seemed really to revel in the warm solar bath. Thirty feet or more beyond me there flourished a particularly handsome tree of this kind, and as I gazed at it in my admiration of its sylvan beauty, my eye caught the sight of a new-made nest in its first fork, and upon this sat its owner, that most winning of all the thrushes known to me, the Wood Thrush. With her great, warm eyes she watched my every movement, and I, in turn, enjoyed to the fullest extent her avian charms. No wonder her mate had fallen in love with her, for was ever a creamy white breast more elegantly dappled with great, round, brown spots, any one of which would vie with the mole upon the alabaster shoulder of the veriest Venus alive; or did the sun ever shine upon a back of any rarer, or any richer russet than hers? She permitted me to come very close to her, but then taking alarm, she appeared in an instant upon the edge of her nest, and in the next moment darted through the trees and was gone.

Passing my hand into her warm nest, I found it to contain three eggs of a uniform light blue color, and without any further disturbance I withdrew. On another day the spot was revisited by me, and this time my lady exhibited a far greater degree of concern, and her cries soon " called the neighbors in." There were now two callow nestlings in the place of the three eggs formerly seen; and they crouched very low, and, side by side, were as rigid as two lifeless little models during my entire examination of them.

Lifting one of these turdine babies out, by seizing hold of its delicate flesh-colored legs, its entire demeanor at once changed, for 'twixt struggles, squeals, and squalls, it raised a merry row, that at least had the effect of causing the parents and their sympathizers to redouble their bewailments, and so far excite my compassion that I soon replaced the little scamp in the nest.

A few days after this event I was enabled to get a fine photograph of this entire structure *in situ*, with the thrushlings in it fast asleep. It represents a typical specimen of the nest of this species, and the bird seems to have followed a certain plan of building for many years. Upon carefully observing this plan, and taking cognizance of the materials employed, I find it to agree exactly with a description of the Wood Thrush's nest given us by the observant Wilson, perhaps full ninety years ago. He said: "Outwardly it is composed of withered beech leaves of the preceding year, laid at bottom in considerable quantities, no doubt to prevent damp and moisture from ascending through, being generally built in low, wet situations; above there are layers of knotty stalks of withered grass, mixed with mud, and smoothly plastered, above which is laid a slight lining of fine, black, fibrous roots of plants." Surely it is a remarkable fact that this species should always use in the basic structure of its nest the "withered beech leaves of the preceding year," and not occasionally select something else. Yet they never seem to, in this latitude, at least. I suppose, where they breed in the far south, and where, perhaps, beech trees do not grow, they are obliged to choose otherwise, and it would be interesting to know more about this.

Notice in my photograph (Fig. 75) how beautifully the horizontally expanded maple leaves growing above this nest shade its tender inmates from the, perhaps, too warm sun's rays of early summer. This canopy must likewise be grateful to the sitting parent during the time she covers her eggs and performs her incubatory duties.

Birds' nests are difficult and extremely tedious objects for the ornithological artist to draw, and I dare say more or less surprise would be expressed by Wilson, were it possible for him to see my photograph of the nest of this species, and know that such an accurate representation of it had been secured by me in the fraction of a second. Most of the pictures of birds' nests that I have seen in works devoted to such subjects, where they have been reproduced from hand drawings, have been very unnatural looking affairs. They never fail to remind me of the story of the little boy who showed his father his juvenile attempt to depict one of these objects. His father, after contemplating the work of art for several minutes with marked care and pride, and being after all at a total loss to perceive what it was intended to represent, exclaimed: "Yes, my son, that is capital; to have

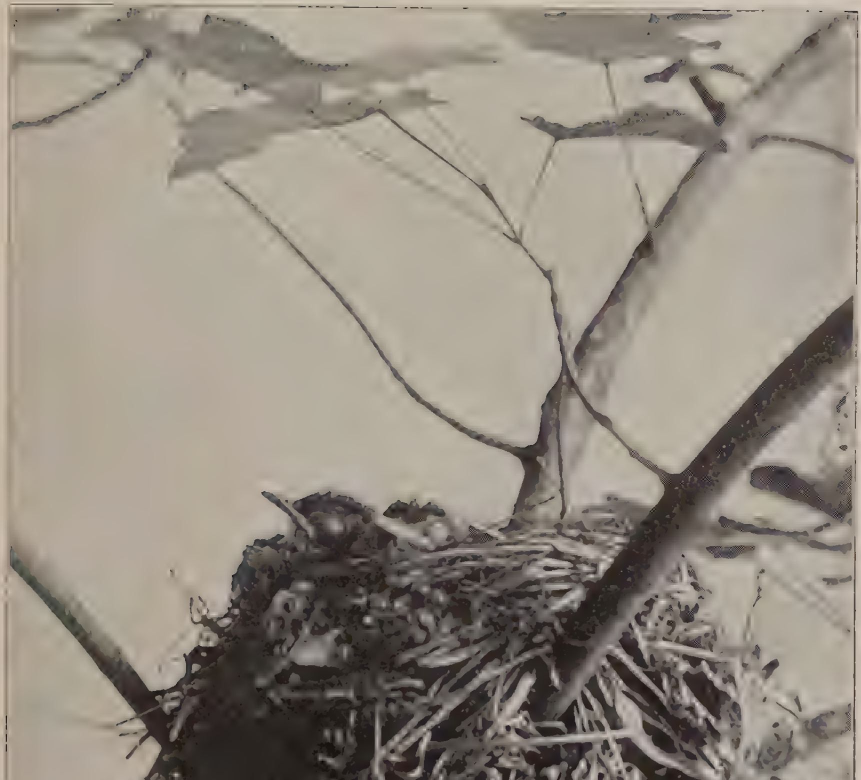

Fig. 75. Nest of Wood Thrush (*Turdus mustelinus*).

Reduced. From a photograph by the Author.

been done by one so young, it is the best drawing of a cyclone that I have ever seen."

One of the most extraordinary things about young thrushes is to observe the rapidity with which they grow. Those which I have kept—and there have been many of them—and fed upon insects and bird food, have thriven marvelously. They by a week's growth double their bulk, and from not handsome, pinfeather-bedecked younglings, they pass into a stage when they become very trim and pretty little fellows. One at about this period of its existence I have likewise made a photographic picture of, and its reproduction is well shown in Fig. 76. About this time they require not a little care and attention, being hearty eaters, and but slowly become accustomed to cage life. Once reared, however, a wood thrush is an elegant bird for a pet—beautiful in plumage, graceful in demeanor, and rich in vocal powers.

The supreme admiration in which I held the Wood Thrush, as a boy, has by no means diminished with advancing years. Indeed, I believe my appreciation of him is greater now than it was then. Prince of thrushes, he has no peer in all this land, save the Mocking bird; and, for one, I must believe that in reality he is a handsomer bird even than old *Mimus* himself. Plump in form, and with fluffy feathering; delicately fashioned legs, of a clear flesh color; an unusually broad tail; dainty, yet dignified in carriage; and with an extremely attractive general contour, made the more so by the possession of such large and expressive brown eyes—surely, he stands without a rival amidst all the *Turdidæ*. Above, his feathers take on a rich fulvous color, that passes to a bright reddish on the crown, and to a fine brown olivaceous on rump and tail. Beneath he is white, the throat and breast being tinged with a cream buffy. Upon either side, from the angles of the mouth, pass down a chain of blackish flecks; these becoming gradually larger, spread out finally over all the breast as an elegant array of rounded or subtriangular spots. The white belly is only in part similarly ornamented, and they cease entirely before arriving at the vent. Inside, the mouth is a clear, fine yellow, while the beak is a dusky brown, being much higher colored at the base of the lower mandible. On top of the head the feathers are inclined to be a little longish, and these, as well as those of the rump, he has a way of elevating when anything especially interests him, and that in a manner quite fascinating to the admirer of the behavior of birds of this kind. Withal, he is an undoubted beauty, nor do his charms cease here, for as a songster he commands a talent and a power peculiarly his own. None of our avian performers possess the wonderful ringing, bell-like notes of the Wood Thrush. Usually he is silent in the middle part of the day, unless, perchance, it be a gray day, when—as is invariably the rule for him morning and evening—he will mount to the top of some tree taller than the surrounding ones in some dense piece of timber land, and from there he will pour out, in mellow, reverberating cadence, his several flute-like notes, with a peculiar rippling harmony that once heard can never be forgotten. They are soon answered hither and far in the forest by rival performers of the same species, and that with an apparently increasing ardor and ecstasy, until one can almost believe these feathered challengers are vieing with each other in their efforts to produce the sweetest and softest responses. They close only as night draws on, first one bird and then another rendering its clear, quavering finale, as a parting good-night, to tranquillize the mind of the weary rambler as he trudges homeward, after a long and pleasurable day spent far afield.

Be it said here that next to the fact that all birds possess feathers, is the common character that every representative of this group of vertebrates lay eggs, from the hatching of which their young are brought forth. No such corresponding rules can be drawn in the case of mammals, however, for there are mammals in existence that do not possess hair, as some of the whales for example; nor do they all bring forth their young alive, as the Monotremes, of Australia and the East Indies, lay eggs from which the young are produced.

Now, although all birds lay eggs, the places where those eggs are deposited for hatching are nearly as various as the species of birds themselves, surely far more so than the number of families of the class. Not confining ourselves to any particular country, we may have in the first place plenty of species of birds that make no nests at all to contain their eggs. They simply lay them upon the bare rocks, or the ground. Most all those marine forms known as auks have this habit well marked, as do a great many other species among the lower groups, as for example the albatrosses. Bennett, in describing the King penguins of Macquarrie island, in the south Pacific ocean, said: "The females hatch the eggs by keeping them close between the thighs, and if approached during the time of incubation, move away, carrying their eggs with them."

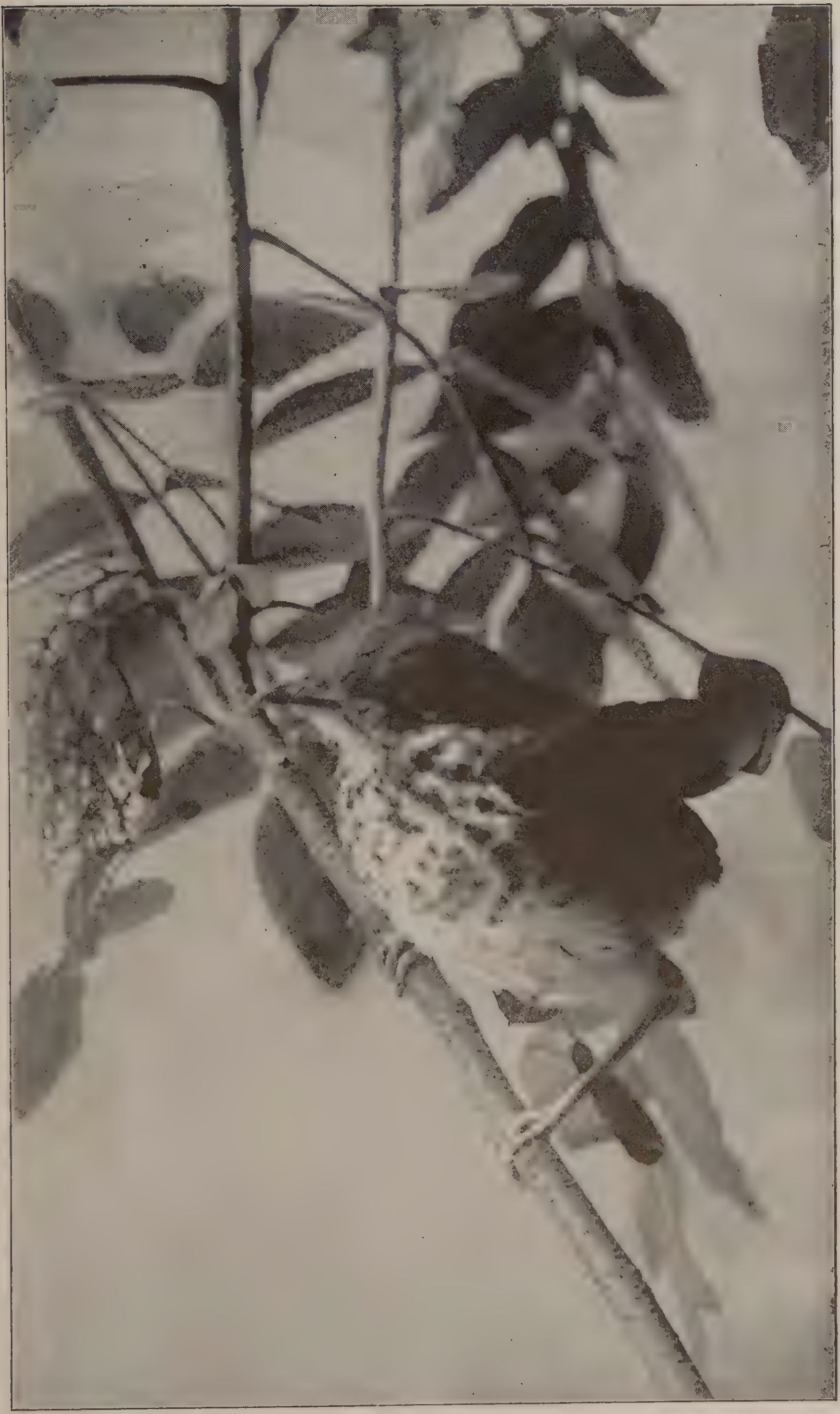

FIG. 76. YOUNG WOOD THRUSH (*T. mustelinus*).
Slightly reduced. From a photograph from life by the Author.

Passing to other sea fowl and shore birds, we soon meet with species that form a very slender nest upon the ground. This may vary all the way from a shallow excavation the bird scoops out to contain its eggs, to where they, in other species, use an extremely meager supply of some material, as grass or moss, to form a very slender nest in the aforesaid hollow. These are rudimentary ground nests of the simplest character; and many gulls, snipe, plover, and their kin, never construct any other kind. On the other hand the puffins dig a shallow burrow for themselves, or they may occupy the burrow of some animal—as that of a rabbit—in which to lay their single egg for hatching *(Fratercula)*; while many cormorants build quite a massive nest of seaweed upon the rocks near the sea, and lay several eggs.

Flamingoes—birds related to certain waders upon one hand and to the swans, geese, and their allies upon the other—construct upon the ground a most remarkable nest, totally unlike anything found in either group. It is several feet high and composed of mud, with a shallow excavation at the smaller end on top, in which the eggs of this species are laid.

Still more singular are the habits of the megapodes of some parts of the Australian region. These birds, as a rule, are about as large as a ptarmigan, and they bury their eggs in the ground, or else cover them over with a mound of earth, sticks, leaves, and similar material. In these situations the young are hatched out without any assistance from the old birds, and the former are highly developed at birth, being full-feathered and fully capable of caring for themselves.

Most ducks, geese, and swans build their nests upon the ground near the water's edge, but in Africa they have at least one species of goose that builds high up in trees, while our own common woodduck builds in the hollow trunk of some dead tree, or usually in a hollow, horizontal limb many feet above the ground.

As we pass to some of the higher groups of birds, we meet with quite a number that build or lay their eggs in the hollows of trees. These hollows may simply be the natural ones, or the natural ones cleaned out by the birds; or they may be excavations made wholly by the birds themselves, as among the woodpeckers. Among some of the great hornbills of the east we find certain species that breed in holes of trees, and the male bird, after the hen begins to sit, plasters up the entrance with mud, leaving only a small hole, through which he feeds her during the time incubation lasts.

Many of the herons and their allies build great rough nests of sticks and twigs in tall trees, several pairs building on the same tree. The habit of the storks of Europe of constructing their nests on chimney tops is well known, while some of the nests of the African and Oriental species of this group are most remarkable affairs.

In the days when our wild pigeons were in millions in this country, they frequently built as many as 150 nests in one tree, legions of these birds congregating together in the forests for the purpose during the breeding season, and hundreds of trees were thus occupied. Parrots, as a rule, lay five or six eggs in the hollow trunks of dead or decayed trees, making little or no nest. But when we come to study such forms as the European cuckoo, or our own Cow blackbird, an entirely new departure is met with, for these birds never make any nest of their own at all, preferring to lay their eggs in the nests of other species, where they are hatched and the young ones reared by the foster parent.

Quite a number of our vireos build beautiful pensile nests, twixt the forks of some small branch of a low tree. In Fig. 77 I present a photograph of one of these neat nests from my own collection. Strange to say, it only contained one young at the time of its discovery. This bird is abundant in eastern North America.

Various species of humming birds build nests that are truly wonders as examples of avian architecture. Some are extremely small; some are pensile, others are sessile; many closely mimic their surroundings, as the knots or other growths upon trees; often they are most delicately constructed, and covered over with moss or lichens; finally, there are others of odd shapes. It would be simply out of the question to pretend to give even a brief description of a few of these remarkable structures, and the number of species of humming birds now known to naturalists runs far into the hundreds.

What may be deemed a conventional "nest," as built by an average small bird, is well exemplified in any of those constructed by many of our common sparrows, finches, buntings, and their kin. A very neat one is seen in the nest of our little Indigo bunting *(Passerina cyanea)*, and one of these I have photographed *in situ* to illustrate the kind usually built in a small tree, bush, or thicket. It is composed of dry leaves, grasses, fibers, and finer materials for a lining. In the case of this nest

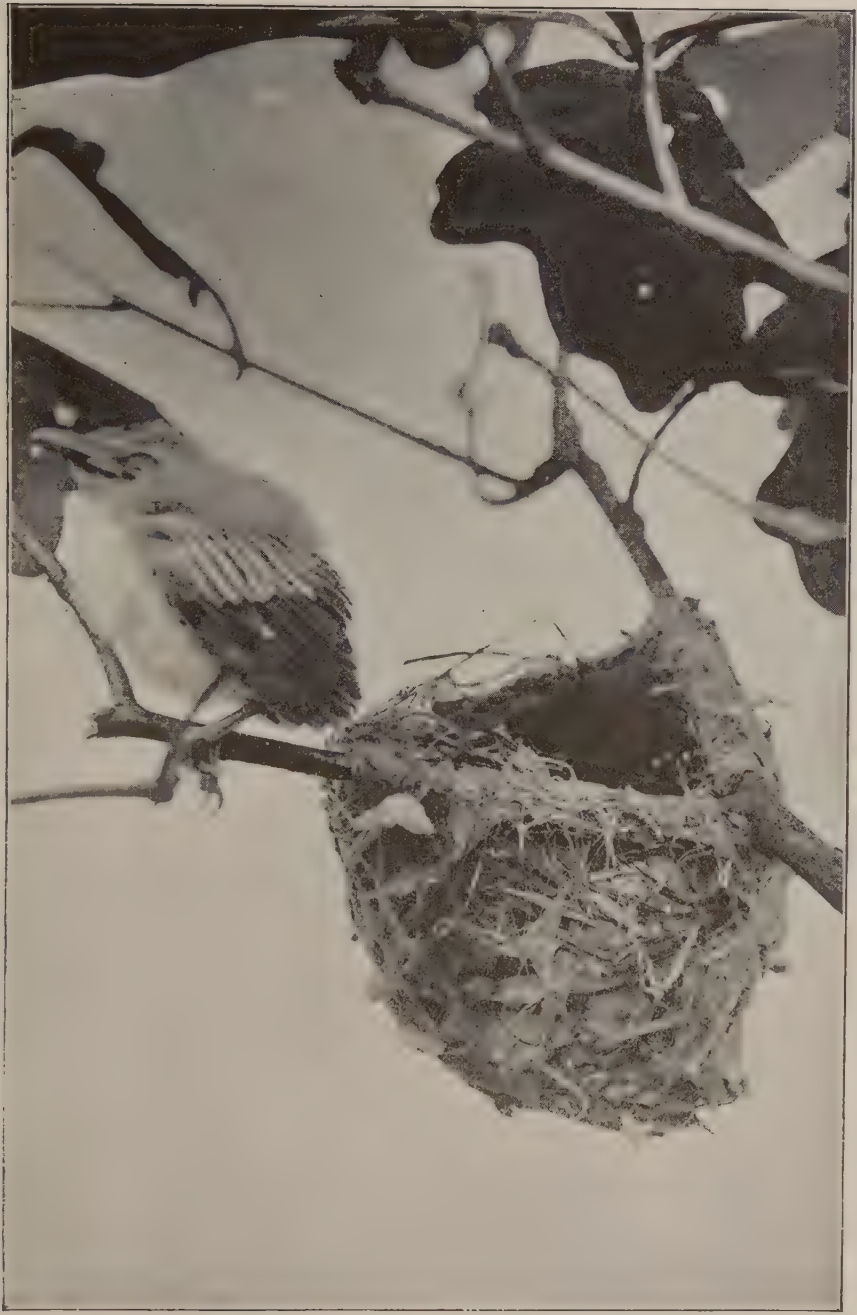

FIG. 77. NEST AND YOUNG OF THE RED-EYED VIREO (*Vireo olivaceus*).

Photographed natural size from life by the Author.

the birds did not place it close down in the fork; other fringilline species do; while many others, as some sparrows and towhees, build on or very near the ground.

All of the passerine birds, however, by no means build these conventional nests, for many of the orioles, for example, construct pendent, pouch-like affairs, with an opening at or near the top, the structure, as a whole, hanging from the extremity of the slender, waving twiglets of such trees as the willows, or similar varieties where these do not occur.

In Africa and India we meet with many genera and species of small birds that have been familiarly called weaver birds from the very fact that they do weave such ingenious as well as curious nests. For example, in the genus *Euplectes*, we find a bird weaves a nest having the form of a chemist's retort. This is swung at the extremities of the twigs of any willow-like tree in such a manner that the globular portion is uppermost, while the elongated neck just clears the water beneath. By such a contrivance the eggs of this species are comparatively safe against the attacks of monkeys and snakes.

Still more remarkable are the nests of the sociable weavers, birds which unite in a community of several hundreds, and in some tree construct a common thatch roof, often as much as ten feet square, under which they build their nests in common. An entire chapter might be written upon the habits in this particular of this species, but the limitations of space forbids it in the present connection. Related species to these African weavers also make the most remarkable specimens of architecture. The Bengal weaver bird also makes a purse-shaped nest, suspending it over the water. Each year it weaves a new nest to this, attaching it below, so that in a few years a number of them are strung together, giving the entire structure the appearance of a cylinder of woven grass, with bulbous enlargements at various intervals.

Many of the warblers, the kinglets, the wrens, and others construct wonderful nests. Our marsh wrens also make what are generally termed "cock nests," in which the birds do not lay, but are built here and there about the real or occupied nest, apparently with no other object than to deceive those searching for their eggs. East India has its tailor bird *(S. sutoria* Lath.*)*, that as a means of deception, actually sews with a thread the living leaves about its pouch-like nest together in such a manner as to completely conceal it.

Titmice often construct long, pendulous nests, and many swallows and swifts attach their nests to the surfaces of various kinds, the nests being really but half a nest. As examples of this we have our common Barn swallow and the Chimney swift. The latter, however, uses only small twigs for the purpose, and these are made to adhere together by the aid of an adhesive secretion, the product of two glands possessed by the bird that are in some respects analogous to salivary glands.

The nests of the Esculent swift *(Collocalia esculenta)*, so extensively used as an article of food in China, are somewhat of this variety. Entire books have been written about the nidification of this extraordinary species. Unique nests are likewise made by the famous Hornero *(Furnarius rufus)*, or Oven bird; the Water ousel *(Cinclus)*, the Hammer-head *(Scopus)*, and a perfect host of others. Nests as made by hundreds of other birds, as, for example, the birds of paradise and other East Indian forms too numerous to mention, are as yet entirely unknown to science, nor have our naturalists as much as even seen them.

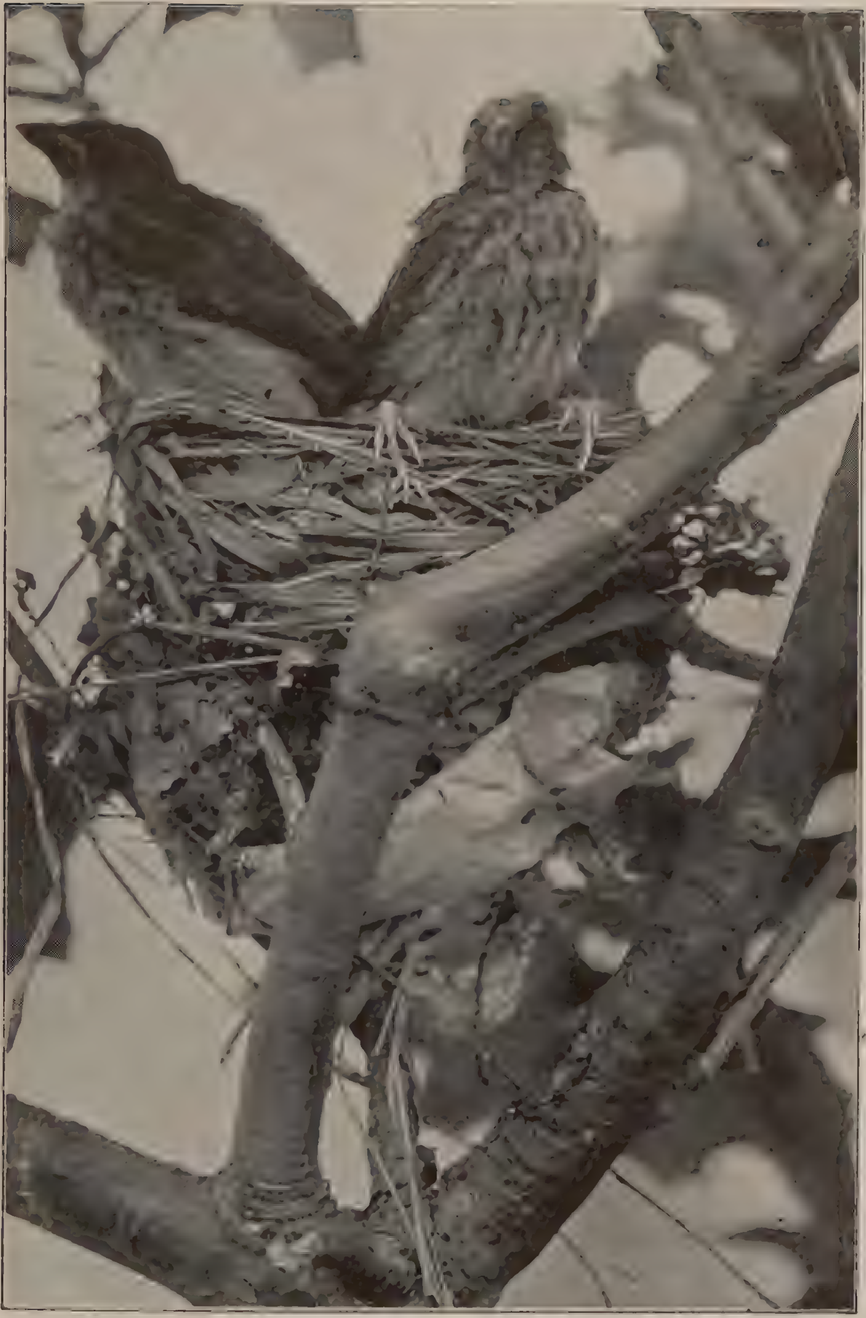

FIG. 78. NEST AND YOUNG OF THE INDIGO BUNTING.

From a photograph taken by the Author. Natural size, from life.

CHAPTER XXII.

THE AMERICAN WARBLERS AND SPARROWS.

(Mniotiltidæ and Fringillidæ.)

MANY naturalists and classifiers of vertebrate forms recognize in birds an Order Oscines, or those representatives of the Class Aves that are distinguished by the possession of true song-muscles. In natural classification, however, the Oscines form but a suborder of vertebrates, but class the group as we may, the fact still remains, that in so far as the United States avifauna is concerned at least, two of the largest families we have represented in the passerine group, or oscines, are the warblers and the fringilline assemblage, or Sparrow-finch family.

In the present chapter it is your author's aim to say something in regard to the number, habits, migrations, and characteristics of these two numerous families of birds, namely, the Warblers of the family *Mniotiltidæ*, and the Sparrow-finch assemblage of the family *Fringillidæ*.

Everyone that knows anything of United States ornithology, knows that the great bulk of our birds pass south during the fall to remain until spring, when they return to breed. Millions of both land- and water-birds perform these autumnal and vernal migrations every year. Many, but not all, pass as far south as the West Indies and South America, every autumn; many, but not all, migrate as far north every spring as the Canadas, while some, especially the water fowl, may go even as far north as the circumpolar regions. Similar migrations of birds take place in the Old World, and, moreover, the phenomena hold true for the avifaunæ of the southern hemisphere. If one should slowly travel from Maine to Florida during the months of March, April, and May, carefully observing the birds along the route, in all kinds of localities, that traveler would find that as he gradually passed southward, new bird-forms were constantly being met with not found in the regions left behind. In other words, for reasons or laws little or not at all known to us, birds, or rather certain birds, have their normal limits, some species during the spring migration coming so far north but no farther. So, too, with the northern forms. For example, in the fall migration, snowy owls might pass as far south as the middle, or even south-central part of the country, whereas the great gray owls would not be found south of the Great Lakes. Exceptional stragglers, of course, violate these laws occasionally, and instances may occur where a bird is taken way off its range, far from its normal habitat, but just why the Swainson warblers in the spring come no further north than southern Virginia, while the Yellow warblers *(D. æstiva)* will extend their migration at the same time as far north as the fur countries, is something that, as yet, no one has satisfactorily explained. On the Pacific coast, and throughout the great central valley of the Mississippi, the same phenomena confront us. Then in nearly all geographical areas there are a few birds that are resident, or never perform ordinarily any migrational passages at all, but remain the year round in the land of their birth. We have a great deal to learn in these premises yet; in fact, we have but very little information as to the causes or the origin of facts such as have here been pointed out.

Now if one, familiar perhaps only with our better known birds, —as robins, jays, flickers, chewinks, and the like, will take the pains some morning at daylight to go into the forests, and along the timber-lined streams, either in the spring or autumn, that person will be surprised at the host of various species and subspecies that swarm in the tree-tops and in the undergrowth, the great majority of which average about the size of a chippy sparrow, and are quite unknown to him. If the student undertake to collect these, say in any favorable region in the mid-Atlantic States' district, he will soon find, as his collection runs up into the hundreds, that there will be a long series of the small varieties to which I have just made reference. They have a great similarity of form and size; some are exquisitely beautiful in plumage (especially the male in nearly all cases); while, apart from a few individual specific habits, the behavior of all, in their haunts, is nearly the same. Omitting such species as the kinglets, the tits, wrens, vireos, and, of course, all the fringilline birds, and some of the smaller flycatchers and pewees, we can safely say, in so far as the passerine species go, that the residue of this extensive group belongs to the great American family *Mniotiltidæ*, or the Warblers.

Taken together there are certainly in this country some sixty-four or sixty-five species and subspecies of these warblers; and in thus reckoning, the water-thrushes and chats *(Siurus* and *Icte-*

ria) are not considered, as they do not properly belong within the lines drawn. They have, to be sure, been placed there in the A. O. U. Check List, but I expect that that was done because the compilers of that volume knew of no other taxonomic position for them. As the male and female in nearly all warblers, or at least in a great many of them, have a different pattern and coloration of plumage, this, in a collection of them, makes the forms appear to be even still more abundant; while, in the autumn, the plumages of the grown young are often likewise different and apparently increase the number of kinds yet still more. Close study, extending over many seasons can alone familiarize the student with these problems, and render him capable of selecting and naming (technically and in English) the various species and subspecies in such a collection, designating at the same time the females and grown young in their various plumage phases. Very few American ornithologists indeed can, offhand, perform this feat to-day, and if the young plumages are entered in the list, it is safe to say that there is no one living that can do it. These warblers may be classified in about a dozen genera, the vast majority of them falling in the genus *Dendroica*, it containing nearly thirty specific and subspecific forms; while about a dozen occur in the genus *Helminthophila*, and nine or ten in *Geothlypis*, and so on,—some genera being represented by only one, or sometimes two or three, birds. Warblers are denizens of the forests and woods, and are rarely found beyond their confines. Hardly one of them can be said to warble, as their notes, often low and monotonous, in no way partake of any such character of vocal music. Some of their notes are very sweet, however, and as a whole they materially add to the great avian choir of sylvan performers during the flood of the vernal migrations, at a time when the entire bird-host is in full song. Most of these birds are tree-lovers; others delight in the more humble undergrowth; while a few spend the greater part of their time in bramble or brake, or even upon the ground. All are partial to a great variety of the smaller insects and their larvæ; and of such food they are almost constantly in search. Indeed, were it not for the check caused by our warblers, many insects would soon swarm to an alarming extent, and plant life would suffer accordingly. A great many kinds of nests are built by these birds, as a rule most of them being tree- or shrub-builders, and exhibit wonderful taste and delicacy in the structures. Great ingenuity is also shown in the selection of sites, and it is the exception in all these particulars to find a warbler's nest that is not a real object of beauty, with lovely surroundings. Taken as a group, the predominating colors of the plumages are black, white, yellow, brown, olives, blues, grays, the duller greens, but very rarely any of the reds or scarlet, or other intensity of coloration. The young have different plumages, always being duller, during the subadult stages. As a rule, warblers lay from two to five eggs, or three to four; they are usually white, and exhibit various kinds of speckling. Ridgway says the Black and White warbler *(M. varia)* embeds its nest in the ground in the woods; while the beautiful Prothonotary warbler *(P. citrea)* selects some cavity in a tree, or a deserted woodpecker's nest, the site being always near the water.

At different times I have succeeded in making photographs of a few of the warblers, with the nests and young of others. From these I select two examples to illustrate the present chapter. The first of these, shown in Figure 76, is a life-size picture of a male specimen of the Black-poll warbler *(Dendroica striata)*, a black and white species, that during some years is very abundant in certain localities. Usually, they are among the last of the family to arrive in the spring, coming after the foliage is well advanced, and, at first, confining themselves to the tree-tops, but subsequently are found diligently searching for their favorite insects among the lower branches. According to the A. O. U. Check-List the geographical range of this species is "eastern North America, west to the Rocky Mountains, north to Greenland, the Barren Grounds, and Alaska, breeding from northern New England and the Catskills northward. South in winter to northern South America, but not recorded from Mexico or Central America." Wilson never saw the nest of this species, and gives but a very meager account of the bird. What there is of it, however, is honest and correct, and this is more than can be said of Audubon's description. Writing of the latter, Dr. T. M. Brewer in the first volume of *The American Naturalist* (p. 120) says, and we may "even be pardoned if we enjoy a quiet laugh over some [of his] conclusions, now known to be visionary, but which his exuberant imagination, now and then, led him to put into printed words." It seems that when on their way with an exploring party to Labrador, they stayed several days at Eastport, Maine. One morning when scrambling round through the brush (or thickets of trees as he called them) with his son John,

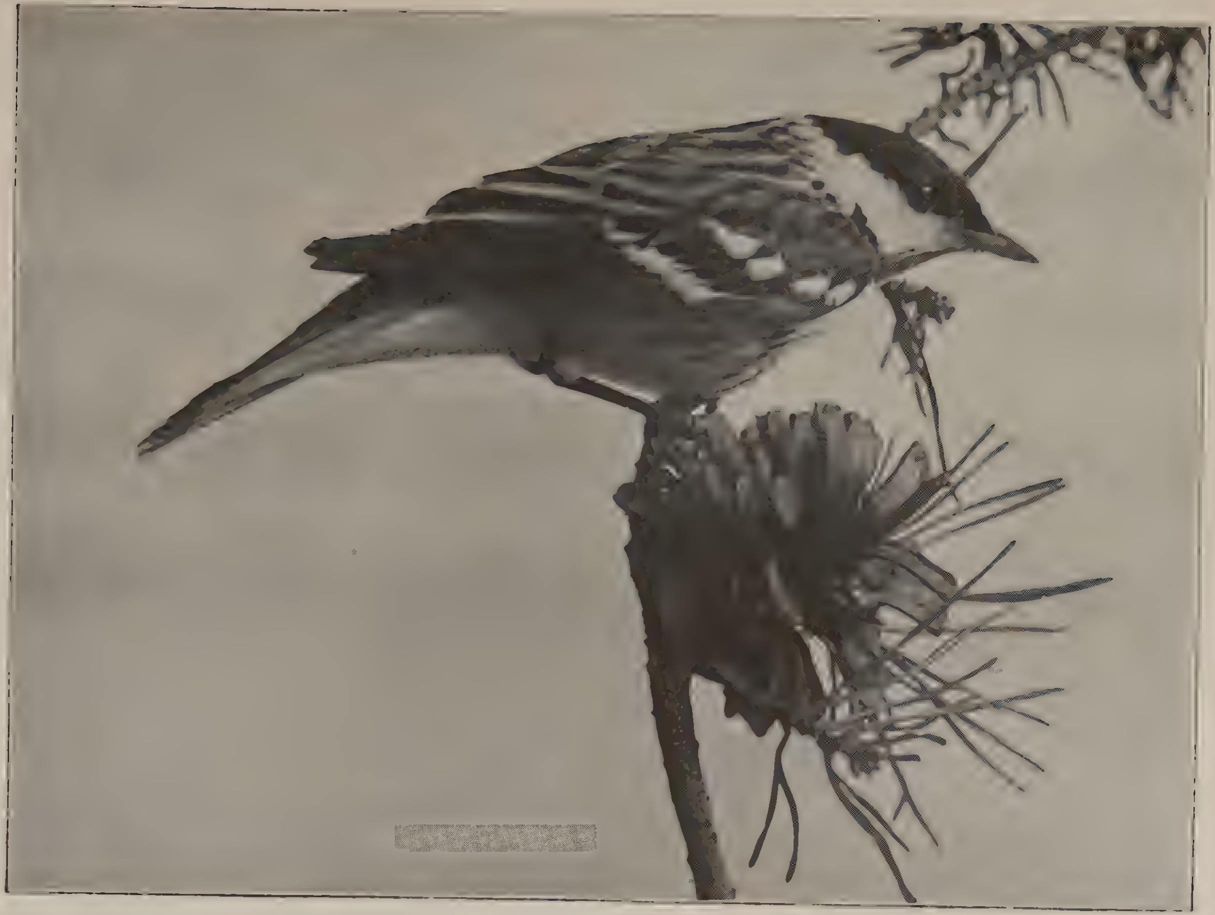

Fig. 79. Black-poll Warbler (*Dendroica striata*).

Adult, ♂; spring plumage. Photographed natural size, from the living specimen by the Author

the latter flushed a female Black-poll warbler from her nest. At this the over-sanguine rather than always truthful, father boiled over, and in his record he wrote the following words: "Reader, just fancy how this raised my spirits. I felt as if the enormous expense of our voyage had been refunded. There, said I, we are the first white men who have seen such a nest." Commenting upon this absurd statement, Dr. Brewer further remarks, "But when we know that Mr. Audubon's whole party started in the expedition from Eastport, in Maine, where they also spent several days before they commenced their voyage to Labrador, and that one of his party was a near resident to Eastport; and when we further know that all around Eastport, and especially on the islands, the Black-poll Warbler is one of the most common birds, we must see at once how far a vivid imagination has supplied the material for his conclusions, and that they had but little foundation in reality." When a vivid imagination supplies the material for conclusions, and that the latter have no foundation in reality, it is very *bad*, and usually has to be *paid* for in the long run. We all admit that Audubon was a great painter, but in not a few of his ornithological descriptions he too frequently drew his inferences from insufficient data.

As a matter of fact this species builds rather a bulky nest, usually on the lower limbs of pine trees, and lines it well with soft feathers. Further to the northward they may even build upon the ground, as has been stated by competent authority. Ridgway has described the young at various stages. Here is where the bulk of the work remains to be done in this splendid group of birds by ornithologists. We need to know a great deal more about the autumnal plumages of all these species and subspecies of the *Mniotiltidæ*. But this applies even more directly to the *young*, that is from the time they assume the first nestling plumage, through the various stages until it becomes *completely* adult. This can only be done by collecting long series of birds of the same species or subspecies for all the variations. My son has been engaged upon this lately, and this spring succeeded in taking several birds of this group in plumages not possessed in the immense collections of the United States National Museum. Even one or two of these the ornithologists in that institution have failed to identify, while in some cases the young or subadults have been taken in plumages heretofore undescribed, or even unknown. There is a superb field still open here for work of great value in this, one of our most interesting groups of birds, and one exclusively American, as these Warblers have no near representatives in the Old World. A handsome volume, giving full descriptions of everything known of our warblers, with a complete set of colored plates giving life-size figures of the members of the family, would at this writing be a magnificent contribution to ornithology. In such plates all the various color phases of the young and subadult, for each and every species or subspecies could be shown, as well as half-tone figures in the text (from photograph) showing their nests. All the eggs could be exhibited upon three or four plates in the same masterly manner in which Bendire has done for other groups.

Speaking of the nests of these birds, I discovered this spring (1897) a most beautiful one of the common Yellow warbler. Strange to say it was built *obliquely* (see Fig. 80) upon the side of one of the upgrowing shoots of a honey locust. The foliage was very dense, and apparently a secondary growth from an old stump; it was upon the "flats" of south Washington, a semi-swampy area on the north side of the Potomac, but less than a quarter of a mile from the Washington Monument. The last young one of the brood was just about to leave it, but was captured; the male parent only exhibiting any concern. Now, although the old birds of this species are of a bright yellow all over, this young, fluffy one was white beneath and a pale pearl gray upon all the upper parts. In fact, not at all suggestive as to the species to which it belonged. The nest is an extremely neat little affair, and securely fastened to the limb or shoot. My friend, Mr. Chas. R. Dodge, of the United States Department of Agriculture, has kindly examined the fibers of which this nest is chiefly composed, and he writes me that they are doubtless those of the common swamp milkweed *(Asclepias incarnata)*.

Another warbler that constructs a pretty nest is the Prairie warbler *(Dendroica discolor)*, and several of these were found by my son and myself during our collecting trips in the spring of 1897, in the neighborhood of the city of Washington, D. C. They are fond of building in the low, second-growth timber, composed of scrub-oak, chestnut, dogwood, and similar trees. On the eighth of last June (1896) a very pretty specimen of the nest of this species was discovered in the fork of a small oak, not more than three feet above the ground. It contained four eggs, and these hatched out in the course of the next few days. At first,

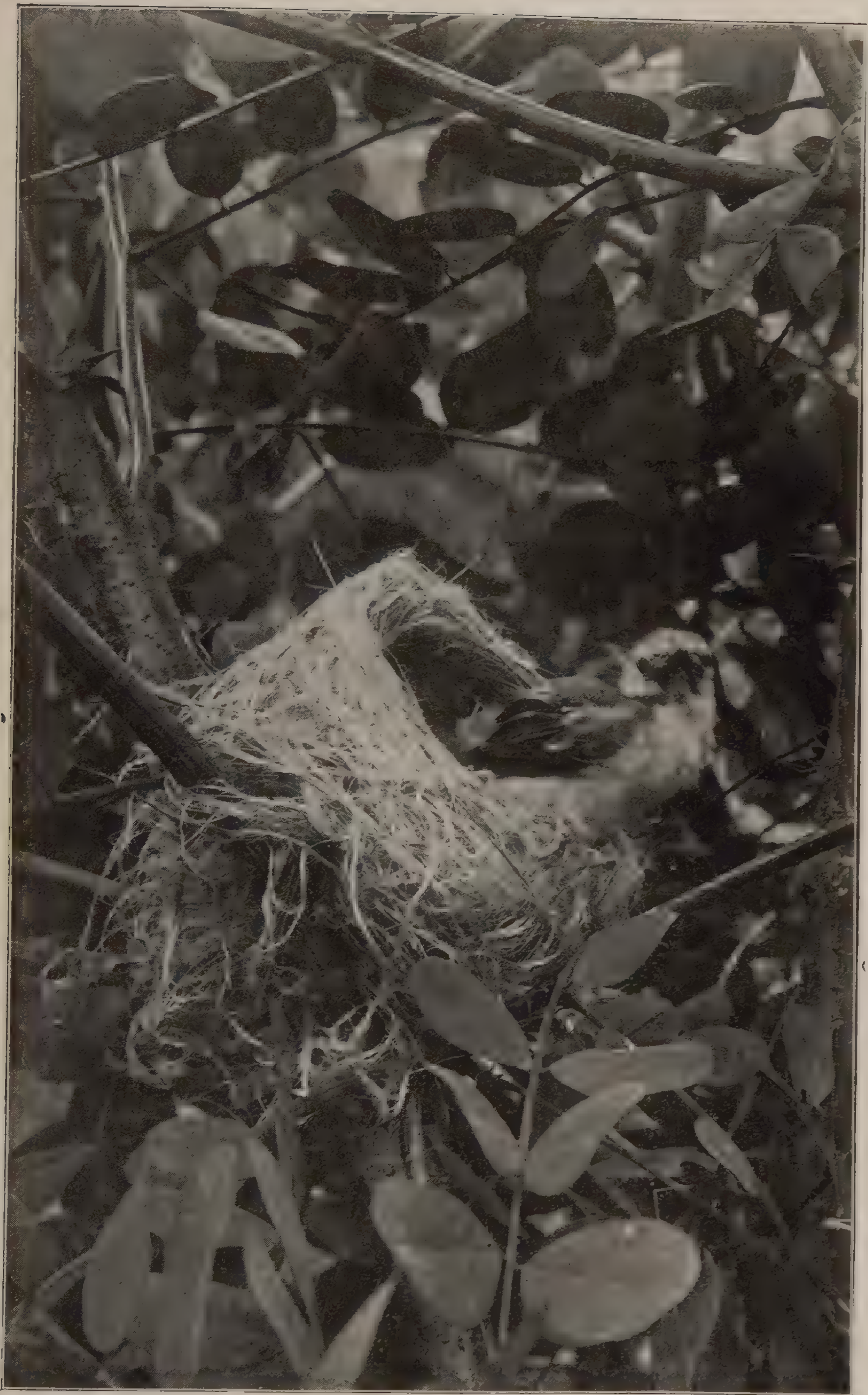

FIG. 80. NEST AND YOUNG OF THE YELLOW WARBLER (*Dendroica æstiva*).

Taken natural size, *in situ*, from nature by the Author.

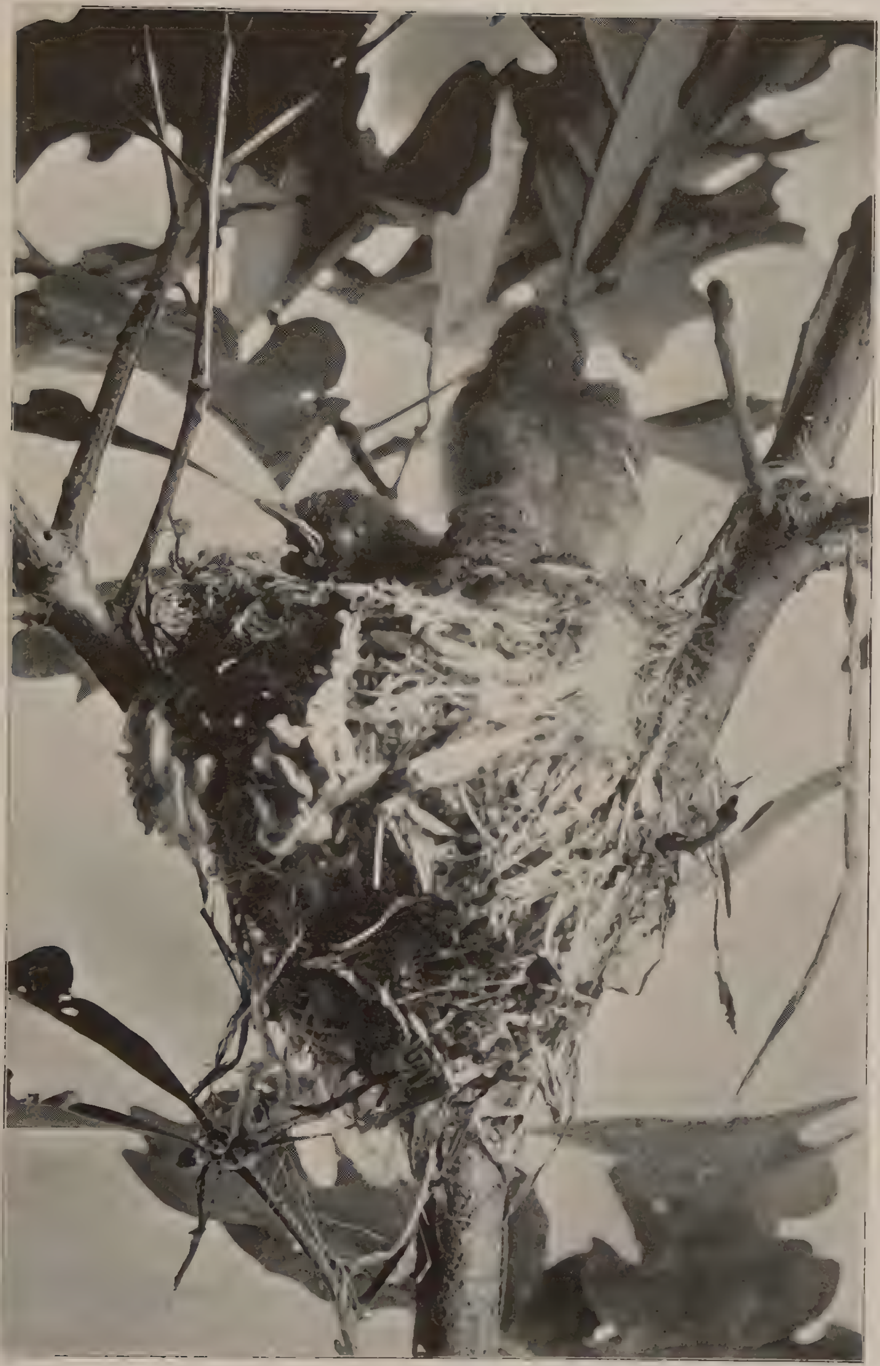

FIG. 81. NEST AND THREE YOUNG OF PRAIRIE WARBLER.

the birds are not much bigger than young humming-birds, but they grow rapidly, and, at about the time they were ready to quit the nest I made a photograph of both, taking it of natural size. (See Fig. 81.) Upon examining the structure of this nest I find it to be composed of the following materials: inside it is somewhat thickly lined with the very finest kinds of grass, vegetable fibers, and the white hair of some animal,—the three being beautifuly interwoven in such a way as to give a smooth and even surface. This lining is completely blended with the outer structure of the nest, in which latter much of the same material is used, but to this part of the structure the birds had added bits of white string, feathers, rather coarser grasses, scraps of cotton, and tiny pieces of wool, and similar materials. The weaving is extremely intricate and close, and the nest below is built around little limbs of the fork that supports it. In form it is deeper than it is broad, being somewhat sub-ellipsoidal in general contour. They do not vary much, though one that my son found had a good deal of cotton in its composition.

Some of these warblers are very beautiful birds, as, for example, the Prothonotary *(P. citrea)*, the Magnolia *(D. maculosa)*, the Cerulean warbler *(D. cærulea)*, the Blackburnian *(D. blackburniæ)*, and others; some are rare, as Swainson's or Kirtland's *(H. swainsonii* and *D. kirtlandi);* others again are extremely plain in plumage and seclusive in habit. They are, however, all deserving of our closest study, and any one adding reliable data to the known chapters in the history of any of them will be doing ornithological science a distinct service and benefit.

Passing next to the family *Fringillidæ*, we find it to be represented in the United States avifauna by a large and varied collection or assemblage of birds, of which the Grosbeaks, the Buntings, the Towhees, the Finches of different species and subspecies, the Sparrows, the Snowbirds and others, are all characteristic examples. The study of this large and extensive group of forms is extremely interesting and important, especially when we come to consider their number, their habits, their wide geographical range, their morphology, and their economic relation to man. But it is not my intention to enter upon any of these subjects in the present connection, as even a general consideration of them would far exceed the limitations of our space. It is my desire simply to bring before my readers certain comparative data by means of which I hope to make clear to them the growth of American ornithology along certain lines during the past century. This is the reason why I select a large and familiar group of birds (of the suborder *Passeres*) to illustrate what I have in view, for nearly everyone in the land knows the more common representatives of this tribe; as, for instance, the American Goldfinch, the Chipping sparrow (see Figure), the Snowbirds, the Chewinks *(Pipilo)*, and others.

Not long ago the American Ornithologists' Union published a second edition of its Check-List of North American Birds, and in it is given the scientific and English name of every species and subspecies of bird of this country. The first edition of this work appeared over ten years ago, and the present writer has compared the two volumes in such a manner, in addition to other data, as to show the number of new birds made known to science and named in the last one. These results were duly published in *The American Naturalist*, of Philadelphia, of last year (1896). But these show only the number of new species and subspecies of birds discovered in this country during the past ten or twelve years, whereas it can be shown that the widening of our knowledge in similar fields during the past century has been simply wonderful.

Let us start from the time of Wilson, for example, and his name, that of "the American ornithologist," as he has been fondly called, is known to all of us. Alexander Wilson was born in 1766, and died in 1813, so the most of his ornithological work was performed about a century ago, and it is proposed here to compare, in a general way, the number of *Fringillidæ* (Sparrows, etc.) known to Wilson, with the number named in the A. O. U. Check-List. With such a selected example as this before us, it will not be difficult for those who are more or less interested in American ornithology to gain some idea of what the entire extension of our knowledge has been in these fields.

I have before me what I take to be an alphabetical list of the birds of this country as they were known to Wilson, and quite apart from the synopsis of Dr. Brewer that subsequently appeared in some of the later editions of the former's work. The first birds to be dealt with in this list are the Buntings, and these, as have the majority of birds since Wilson's time, have all had their scientific, or classical names, changed for them. Of this, little or nothing will be said here, and only to an extent in parentheses as will indicate to the modern student of the science, the

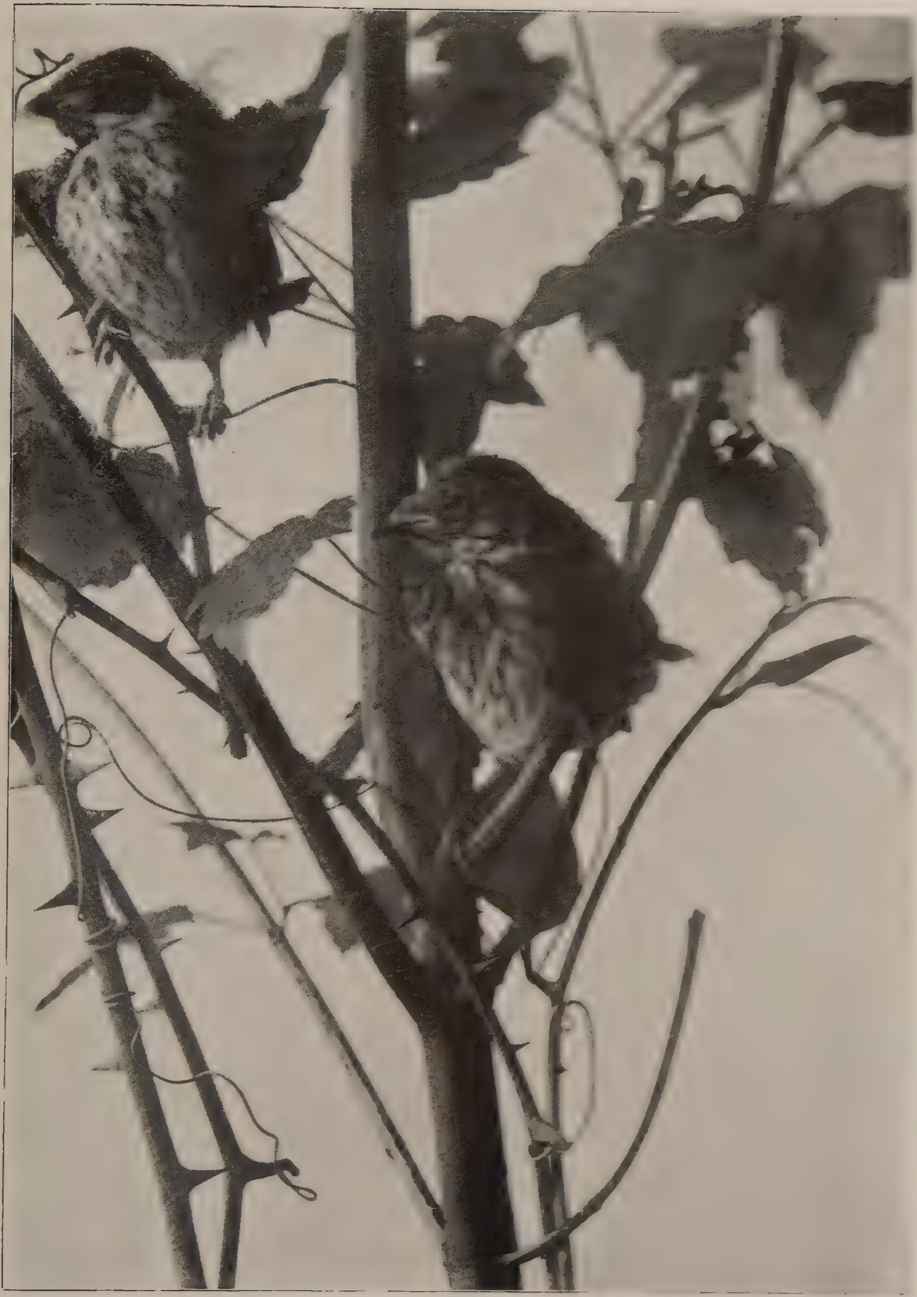

FIG. 82. YOUNG CHIPPING SPARROWS (*Spiz*[illegible]

Three days out of the nest, waiting to be fed. Photographed natural size, from life, by the Author from specimens captured and presented to him by Miss Alfhild D. Lowun

genus dealt with in comparison, the one in the A. O. U. List being used. Wilson knew of but eight birds that he called buntings, the first of these being the Bay-winged bunting, now called the Vesper sparrow *(Poocætes)*, and to it two subspecies have been added since his time. The Black-throated bunting (2), now widely known as the Dickcissel *(Spiza)*, still remains the sole representative of its genus. The Cow bunting, as well as the Rice bunting of this author, are members of the family *Icteridæ*, so this reduces his list of these birds to six. Next, of the genus *Passerina*, Wilson knew of the Painted bunting *(P. ciris)*, still so called (3), and the Indigo bird *(P. cyanea)*, our Indigo bunting. Two other beautiful species and a subspecies have been here added since his time. One Snow bunting (4) was known to Wilson, our Snowflake *(Plectrophenax)*, and the genus has been increased by another species and a subspecies; and while he knew of but the one Towhee *(Pipilo)* (5), we now recognize no less than four species of this familiar bird, and eight subspecies. Equally remarkable is the record for the White-crowned bunting (6), our White-crowned sparrow *(Zonotrichia)*, of which he knew but the one species, while the genus now contains four species and two subspecies, the only other one of it known to him being the White-throated Sparrow *(Z. albicollis)*.

Wilson knew both species of those very interesting birds known as crossbills *(Loxia)*, to which is now to be added the Mexican crossbill *(L. c. stricklandi)*, and the American crossbill has been reduced to a subspecies *(L. curvirostra minor Curvirostra americana)*. These birds are so remarkable, meriting as they do a special description, that I shall at the close of the present chapter, give a special account of them.

Of the genus *Spinus*, Wilson knew of but one little common Yellowbird, or Goldfinch, and the Pine siskin, or, as he called it, the Pine finch, while we have since discovered or added to the avifauna no less than three other goldfinches with their three subspecies. Our well-known Purple finch *(Carpodacus)* was, of course, familiar to him, but the genus now contains, in addition, two other species and two subspecies.

Wilson also described the Savanna finch, the Seaside finch, and the Sharp-tailed finch, all of which he retained in the genus *Fringilla*. These birds are now placed in the genus *Ammodramus*, and including those just mentioned, it contains no less than ten species and eleven subspecies. But even still more interesting is the fact that he placed all the grosbeaks known to him in the genus *Loxia;* these were the Blue grosbeak, the Cardinal, the Pine, and the Rose-breasted. At the present time an Evening grosbeak is known to us, with its subspecies *(Coccothraustes);* the Pine grosbeak still remains unique *(Pinicola);* three subspecies of the Cardinal grosbeak have been discovered *(Cardinalis)*, and an entire new related genus *(Pyrrhuloxia)*, containing the Texas cardinal with its two subspecies; the Rose-breasted grosbeak is now associated in the genus *Habia* with the beautiful western form, the Black-headed grosbeak, the existence of which Wilson never even had a suspicion. The Blue-headed grosbeak is also in a separate genus *(Guiraca)* with its western subspecies. He knew only of one Redpoll, our well-known little type of the north *(Acanthis linaria)*, and to this genus has been added another species and four subspecies.

When we come to the Sparrows, we find that our modern list has been enormously increased since the early part of this century, for Wilson mentions but eight Sparrows, every one of which he retains in the genus *Fringilla*, along, as has been pointed out above, with some of his finches. The genus *Spizella* contains seven species and three subspecies, and it is in this that we find the Chipping sparrow, the Tree sparrow, and the Field sparrow, the only ones known to Wilson. He knew, also, the Fox sparrow *(Passerella)*, calling it the Fox-colored sparrow, and we have found since his day three subspecies of this beautiful bird.

It is curious to note here that Wilson called the male of our Savanna sparrow *(Ammodramus s. savanna)* a finch, while the female of the same bird he called a sparrow; he, however, recognized the fact that it was one and the same species.

Everyone knows the Song sparrow *(Melospiza fasciata)*, and it alone was known to Wilson. In these days, however, this genus contains no less than four additional species, together with ten subspecies. Of these, Wilson only knew, besides the Song sparrow (already mentioned), the Swamp sparrow *(M. georgiana Fringilla palustris)*. He was familiar with the White-throated sparrow of the genus *Zonotrichia*, already referred to above; as he was with the Yellow-winged sparrow, now called by many the Grasshopper sparrow of the genus *Ammodramus*, also mentioned in a former paragraph.

Finally, Wilson knew of but one Snowbird, his *Fringilla hud-*

sonia, the form now called, in the A. O. U. Check-List, the Slate-colored junco *(Junco hyemalis)*, to which genus has since been added no less than seven additional species and seven subspecies. Many of the modern genera of the family *Fringillidæ* were totally unknown to Wilson as, for example, *Leucosticte*, *Rhynchophanes*, *Chondestes*, *Amphispiza*, *Euetheia*, and *Calamospiza*, and of course the forms that represent them.

In summing up, then, it will be seen that Wilson knew of but thirty species of birds that belong to the family *Fringillidæ*, while in our Check-List of 1895 the same family is represented by no fewer than eighty-nine species and seventy-four subspecies—163 birds in all. A large part of this augmentation has been due to the activity of modern ornithologists collecting west of the Mississippi river, over areas which, to Wilson, were totally unknown.

In other lands than the United States, the fringilline or finch-group includes an enormous number of specific and subspecific forms, famous among these we find the Weaver-birds of Africa; the European Haw-finch or Common Grosbeak of Europe; the Common Sparrow, which has been so successfully introduced into this country; the foreign Linnets, the Common Goldfinch of Europe, the Canary, the European Ortalan, the Bullfinch, the Java Sparrow, and a perfect host of others.

As stated above, I shall now give a brief account of the species of crossbills found in this country. These birds average about the size of an English sparrow *(Passer domesticus)*, but they present a character no less unique than the crossing of their bills,—a feature not at present known to exist in any other species of the entire class *Aves*. Both the upper and lower bills are subcrescentic in form, the margins being sharp, and the apices extremely acute. Passing from base to apex, the lower bill is gradually curved to one side, the upper mandible having a corresponding curve to the opposite side, and both present a decided curvature of their own. This arrangement admits of the mandibles crossing each other near their middle thirds, and in this crossing the point of the lower jaw turns out to the right side. I have met with about one specimen in fifteen where the crossing takes place in the other direction. The peculiar conformation of the beak of these birds is not confined only to their horny sheaths, but the asymmetry is still more profound, being entered into by the osseous mandibles of the skull, while certain muscles of the head, the ligaments, and other parts, exhibit a corresponding and proportionate distortion.

By this contrivance the bird has the power of forcibly pressing apart the firm leaflets of the cones of various pine trees, and by a dexterous use of the tongue, whipping into its mouth the seeds concealed in the deeper recesses. These seeds form the principal food of the crossbills, though they, in a similar manner, obtain seeds from the " cones " of the tulip-tree or poplar. Apples are also split open in this manner, the birds being very fond of the seeds of this fruit. I have, in Nebraska, seen these birds feeding upon the seeds of the sunflower, in the winter time.

In my drawing illustrating this chapter, I have shown a pair of American crossbills *(Loxia curvirostra minor)*, the male bird being in the act of parting the horny leaflets of a pine cone. While drawing this bird, I had a specimen before me that I shot near Washington, D. C., a number of years ago, and it shows several traces of albinism, the top of the head being nearly entirely white. Crossbills are finches, but they are very curious kinds of finches, having many habits not exhibited by other members of the same family. Wilson used the word *Curvirostra* for the genus containing these birds, but Gesner applied the term *Loxia* (Greek, *loxos* oblique), and this appellation was continued by Linné, and is now the term used by the vast majority of ornithologists the world over. We have three species of them in this country, viz.: the American crossbill, mentioned above; the Mexican crossbill *(L. c. stricklandi)*, and the White-winged crossbill *(Loxia leucoptera)*.

As a rule they are boreal birds, being confined to the northern parts of the eastern United States, except the Mexican crossbill, which is said to be found in the mountains of Wyoming and Colorado, west to the Sierra Nevada, and south through New Mexico and beyond our boundaries. In the winter-time the other two species also come south, especially the American crossbill, which has been taken occasionally in the southern states. The type of the genus, or the Common crossbill, is found in the Old World *(Loxia curvirostra)*, where three other forms of the genus also occur—" two of them so closely resembling the common bird that their specific validity has been often questioned. The first of these, of large stature, the Parrot crossbill, *L. pityopsittacus*, comes occasionally to Great Britain, presumably from Scandinavia, where it is known to breed. The second, *L. himalay-*

ana, which is a good deal smaller, is known only from the Himalaya Mountains. The third, the Two-barred crossbill, *L. tænioptera*, is very distinct, and its proper home seems to be the most northern forests of the Russian Empire, but it has occasionally occurred in Western Europe and even in England." (A. Newton.)

Adult males of the American crossbill are of a more or less bright reddish brick color, with dusky wings and tail. Females are of a plain olive, often tinged with gray or yellow, and generally dashed with darker markings; the latter are always present in the young birds, the grayish-green in them being lighter than it is in the female. Male Mexican crossbills are more brilliant than the males of the common one. A male of the white-winged species will measure from 6 to 6 1-2 inches in length, and is a more graceful bird than the others. It has black wings and tail, the body being of a rich purplish carmine,—dusky on the back. Two broad white bands are seen upon either wing, a character that at once distinguishes this species, and which gives it its

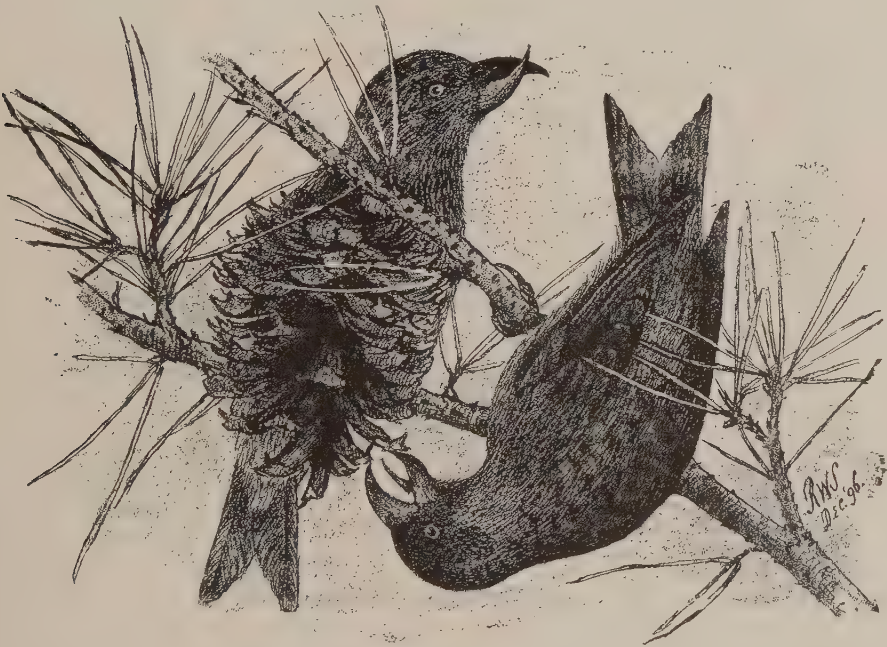

FIG. 83. A PAIR OF CROSSBILLS.

name. About twenty-five years ago I shot several males and females of this white-winged species near Stamford, Connecticut, in August, and found them common in central New York in the winter-time. Females of this variety are also olive-greenish, light-yellowish upon their under parts. Common crossbills are interesting cage-pets, but their bright red tints of plumage frequently, indeed always, I believe, change to a variety of shades of yellowish-red, greenish-yellow, or dull orange. These tints are also found sometimes in adult males in a state of nature. The cause for these changes is not as yet known to us, but the food they eat in a state of confinement may have something to do with it.

Marked variation in size of the individuals is also to be noticed, and their beaks likewise vary greatly in this particular, while in the white-winged species the latter are not so distinctly crossed. Buffon, the great French naturalist, always contended that this crossing was a deformity, and never changed his opinion, and be it added here, probably never saw a flock of them engaged in extracting the seeds from pine-cones. Beyond all doubt, this arrangement has been produced by gradual development in time; and in time, too, the descendants of other species may also possess it—for examples, both siskins and goldfinches constantly feed upon the seeds in pine cones, thrusting their sharp beaks, in the case of the siskins, far in to reach the seeds. A little crossing of the bills would insure their survivance with greater certainty, no doubt.

Wilson, who left us a very excellent account of the American crossbill, says that in the winter they appear in large flocks in Pennsylvania where they feed "on the seeds of the hemlock and white pine, have a loud, sharp, and not unmusical note; chatter as they fly; alight, during the prevalence of deep snows, before the door of the hunter, and around the house, picking off the clay with which the logs are plastered, and searching in corners where urine, or any substance of a saline quality had been thrown. At such times they are so tame as only to settle on the roof of the cabin when disturbed, and a moment after descend to feed as before. They are then easily caught in traps; and they will frequently permit one to approach so near as to knock them down with a stick."

When kept in cages they have many interesting habits, some of which, as holding small cones in their claws while feeding, and using their bills when climbing along the wires, remind us of some of the smaller parrots. Collectors for bird dealers often capture crossbills during snowstorms, with a hair-noose at the end of a short pole. They are thus taken on the cones while feeding.

Sometimes thousands of crossbills will suddenly appear in districts where conifers abound, and after attracting the attention of everyone in the neighborhood, will as suddenly disappear, perhaps after a stay of less than twenty-four hours. Such a flight of the American crossbill I observed here near Washington, D. C., last season, during the latter part of November (1896). Next day all of them appeared to have taken their departure. Occasionally, in New York, I saw both species in the same flock, both being extremely noisy, timid, and restless.

These birds breed in the pine forests of the north, the western form further south than the other two species. The season chosen is either in winter, or very early spring. Ridgway, in describing the nidification of the American crossbill, says "nest rather a flat structure, in coniferous trees, composed externally of spruce twigs, shreds of soft bark, etc., lined with horse-hair, fine rootlets, etc., cavity about 2.50 across by 1.25 deep, external diameter about 4.00. Eggs usually four, .75 by .57, pale greenish, spotted with various shades of brown, mixed with purplish-gray."

Crossbills, in common with so many other animals, have given rise to their special myths. Therefore, we find those who aver that this bird received its crossbill and its blood-tinted plumage "in recognition of the pity it bestowed on the suffering Saviour at the crucifixion." (!) It has been hinted that even Buffon was not altogether averse to this explanation of these two characteristics of the *males* of this genus, quite ignoring the fact that the females show no red in their plumage. Pathologically, crows (and other *Corvidæ*) often exhibit a crossing of the mandible as do some other species of birds.

CHAPTER XXIII.

THE YELLOW-BREASTED CHAT, CAT-BIRDS, AND THE OVEN-BIRD.

(Icteria virens, Galeoscoptes carolinensis, and *Siurus auricapillus.)*

IN the pesent chapter it is my intention to notice one of the most remarkable of all the passerine birds in the avifauna of the United States. Its vernacular name has, ever since the discovery of the species, been the Yellow-breasted chat, and so far as at present known to me, it has, with but few exceptions, passed under no other. But in the hands of the classifiers of birds, and those who christen them with their technical or scientific names, the fate of this species has been very different.

Gmelin, Latham, and Pennant, with their followers, arrayed it with the flycatchers; Desmarest had it among the tanagers; Sparrman and others placed it with the cedar birds, while Linnæus, Buffon, and Brisson believed it was a thrush. The Prince of Musignano took Wilson to task for presuming to think that it could be one of the manakins, and Vieillot adopted its present genus, *Icteria*, for it. This generic appellation, together with the specific one of *virens*, is recognized by the American Ornithologists' Union, and in the Check List of North American Birds, the Yellow-breasted chat, with its western subspecific representative, the long-tailed chat, are made to stand between two genera of warblers, but just why it would be difficult to say.

The bird's exact position in the system will probably not be known, however, until its anatomical structure has been carefully studied, and this compared with that of many other species of suspected alliance. Even this side of the history of the Yellow-breasted chat would incline us to believe we had under consideration one of the ornithological puzzlers, apart from anything else; but its affinities are no more problematical than are the habits of this singular species unique.

Probably few of those who read what I am writing here have ever seen a Yellow-breasted chat, and it is said of Mr. Catesby, who was the first to figure this species, that he was never able to shoot one of them, and finally employed an Indian for the purpose, and even the latter did not succeed until all his skill had been put to the test. Doubtless this story is a little overdrawn, or else Catesby did not collect as well as he wrote; and no one has ever questioned the influence of Mark Catesby's writings. To those accustomed, however, to the collection of all kinds of birds, difficulty is experienced in the case of the present species only from the habit it has of keeping concealed, and that its notes are frequently ventriloquistic in character. Securing specimens of them in plenty has never given me much trouble, either during the vernal or autumnal migrations. Few, though, have fallen to my gun, as to destroy the life of one of those splendid fellows gives me quite as severe a pang and feeling of remorse as it does to shoot a mockingbird.

Wilson, in describing this species, has said that the Yellow-breasted chat "is seven inches long, and nine inches in extent; the whole upper parts are of a rich and deep olive green, except the tips of the wings and interior vanes of the wing and tail feathers, which are dusky brown; the whole throat and breast are of a most brilliant yellow, which also lines the inside of the wings and spreads on the sides immediately below; the belly and vent are white; the front [forehead] slate colored, or dull cinereous; lores black; from the nostril a line of white extends to the upper part of the eye, which it nearly encircles; another spot of white is placed at the base of the lower mandible; the bill is strong, slightly curved, sharply ridged on top, compressed, overhanging a little at the tip, not notched, pointed, and altogether black; . . . legs and feet light blue, hind claw rather the strongest, the two exterior toes united to the second joint."

Very little difference distinguishes the sexes, and the above description is accurate for a number of specimens of this species I have in my private collections. When you catch a glimpse of one of the birds in the thicket, you are at once struck by the marvelous brilliancy of the yellow of its breast; and if the specimen be secured, this is even enhanced by a closer examination. It is surely a rich, pure, and gorgeous shade of that color, verging as it does upon a clear orange in tone.

In the neighborhood of Washington the male chats begin to arrive from the south about the last part of April, the females following in a few days. They depart very early, and it is a rare thing to see one after the first week in September. I remember that in southern New England they used to come early in May, and leave again in August, thus making their stay only a few months.

If upon any fine spring morning in the country, where the Yellow-breasted chat is found, one chances to pass in his rambles into some thicket of hazel bushes, or into the dense undergrowth of brambles, smilax, and wild grape vines, his ears may be suddenly saluted with the grotesque notes of this bird, as he scolds you from the heart of his haunts for the intrusion. You listen, and peer into the thicket with the hope of catching sight of the singular performer, but, for a while at least, all your efforts in this direction are in vain. Although apparently very near at hand comes the anxious and angry repetitions of a series of peculiar whistling notes, the flame-breasted scamp is not to be seen. These notes pass to a hoarse and guttural squawking as they appear to gradually vanish in the distance, and become slower and slower in their utterance. Suddenly, however, and perhaps directly over your head, in the most remarkable manner, they break out again in a loud and perfect jumble of alternate, rapid and slow, cat-mewings and puppy-barkings, intermixed with a selection of other notes quite defying the powers of description. Now they are upon this hand, and now upon that, high pitched and low pitched, until you verily believe the thicket is truly bewitched and full of unseen sprites. In your despair at being unable of even catching a glimpse of the author of this extraordinary tirade, you take on to imitate him. This has a telling effect almost immediately, and in many cases, so to speak, draws him out, for, for the time putting aside his wonderful powers of ventriloquism, and his scoldings taking on a greater degree of vehemence, he at last launches into the air above his retreat, and with cawing notes uttered in varied key, he with jerky flight appears in full view. After ascending some thirty feet or more, he essays to again descend to the brush. This he does with slow flapping wings and dangling legs, in manner indulged in by no other bird known to me. If you persist in your imitations he may follow you along from copse to copse for a quarter of a mile or more, joined, sooner or later, perhaps, by others of the same species. Wilson has very truly remarked: "If the weather be mild and serene, with clear moonlight, he continues gabbling in the same strange dialect, with very little intermission, during the whole night, as if disputing with his own echoes, but probably with a design of inviting passing females to his retreat; for, when the season is further advanced, they are seldom heard during the night."

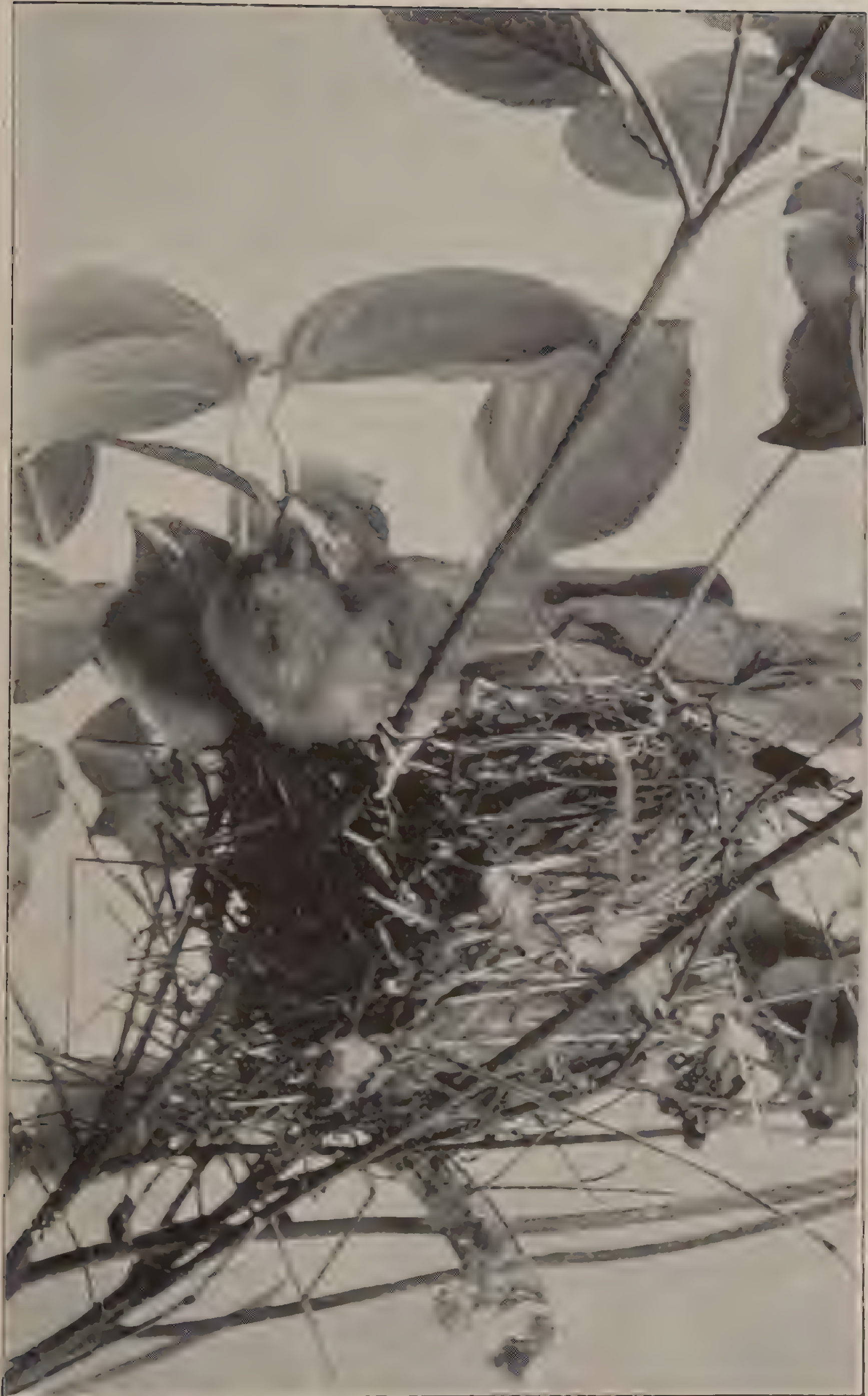

Fig. 84. Nest and Young of Yellow-breasted Chat.
From a photograph from life by the Author, and reduced about one-third.

Some time in May these birds build in the thick undergrowth, near the ground, a light and tasteful nest. They usually lay four eggs of a creamy white color, speckled all over with fine light brown spots. Considerable variation is seen, both in form and color of these eggs, and I have found specimens that were nearly round in contour, and the markings very sparse.

Early last June, near Washington, in a low dogwood bush that grew in the thickest kind of a bramble, I discovered one of these nests containing five young. The former was a very pretty structure, and rested most lightly upon the slender twigs of the chosen bush. In a few days I succeeded in making an excellent photograph of it, at a time it contained two young, ready to leave the place of their birth. This has been reproduced to illustrate the present account, and it gives an excellent idea of the nest of this species.

The young are a dull olive green all over, being lighter and ashy beneath, and the nest I found to be outwardly composed of a layer of very dry dead leaves, followed by a layer of dry grasses and very slender slivers of grapevine bark, to be finally lined with tender, hair-like straws of various kinds. In form it is semi-globular, and quite deep. Contrary to the report usually made by ornithologists, the old birds made no particular disturbance while the examination was being made of either the nest or their young, but simply flipped about from bush to bush, uttering now and then a low, angry, chuckling note.

Often I have found these nests in the smilax vines, or blackberry, or even in a low cedar tree, but never above ten feet from the ground. This is quite in keeping with the habits of the bird, for he is essentially a thicket lover, and it is only through some chance that he is ever seen in the forest or out afield, neither of which haunts are normally frequented by him.

Passing to another family of the passerine birds, namely, the family *Troglodytidæ*, we find a group, in so far as this country is concerned, containing the Wrens, the Thrashers, the Mockingbirds, and the Catbird, and of all of these forms none are more deserving of our study and regard than the often-neglected and abused Catbirds. Now Alexander Wilson was a very close observer of birds, and at the time when he wrote, our feathered favorites in this country had no equal as a describer of their habits and their characters. In my opinion, the description of the Catbird given us by this most charming of ornithological writers is an unrivaled chapter upon the life history of this species, and stands to-day as the most complete account, apart from its anatomy, upon record. He seems to have overlooked nothing in all that goes to make up the history of this, to me, one of the loveliest representatives of the entire group of birds in America.

During the months of May, June, and July of the summer just past, there were an unusual number of catbirds bred in the vicinity of the City of Washington, D. C. Without special search for them, as many as fifty nests of this species must have been seen by me during the period mentioned. As usual, the birds built in the brier and bramble thickets, in the dense vine of the honeysuckle, in the hedge-rows of the osage orange, or in the saplings of the scrub oaks or other trees found in this section of the country.

Last summer a pair of catbirds built a fine nest in the honeysuckle that grows over my porch, close to the dining-room window, and reared five young ones; but I regret to say they did not repeat the performance this year, although the same pair apparently returned and inspected the site of their former home, and then for some reason or other changed base, and built in a thick honeysuckle vine at the foot of the garden. Here they met with dire misfortune, however, for when their eggs were about half incubated, a huge black snake came along one day and devoured them. The pair, assisted by a friend or two of the same species, made it lively for his snakeship for a few moments, in an open space in the garden, but it could be nothing more than by way of retaliation, for the damage had been done then, and the reptile made good his escape through the grass and leaves beneath the thick brush beyond the fence.

When June came about I selected for study a particularly pretty nest of a pair of these birds, with the intention of making photographs of it and of the young it contained. They had laid four eggs when the nest was first discovered, and they were, as usual, of a uniform greenish-blue color, and unspotted. Later, one of these eggs disappeared, and but three of the birds were hatched out.

Nearly every day I visited the small oak sapling in the piece of woods where the pair had built, and one morning toward the latter part of the month it became evident that my brood in gray meant very soon to quit the premises. The moment had arrived for the capture, but this, owing to the denseness of the shrubbery,

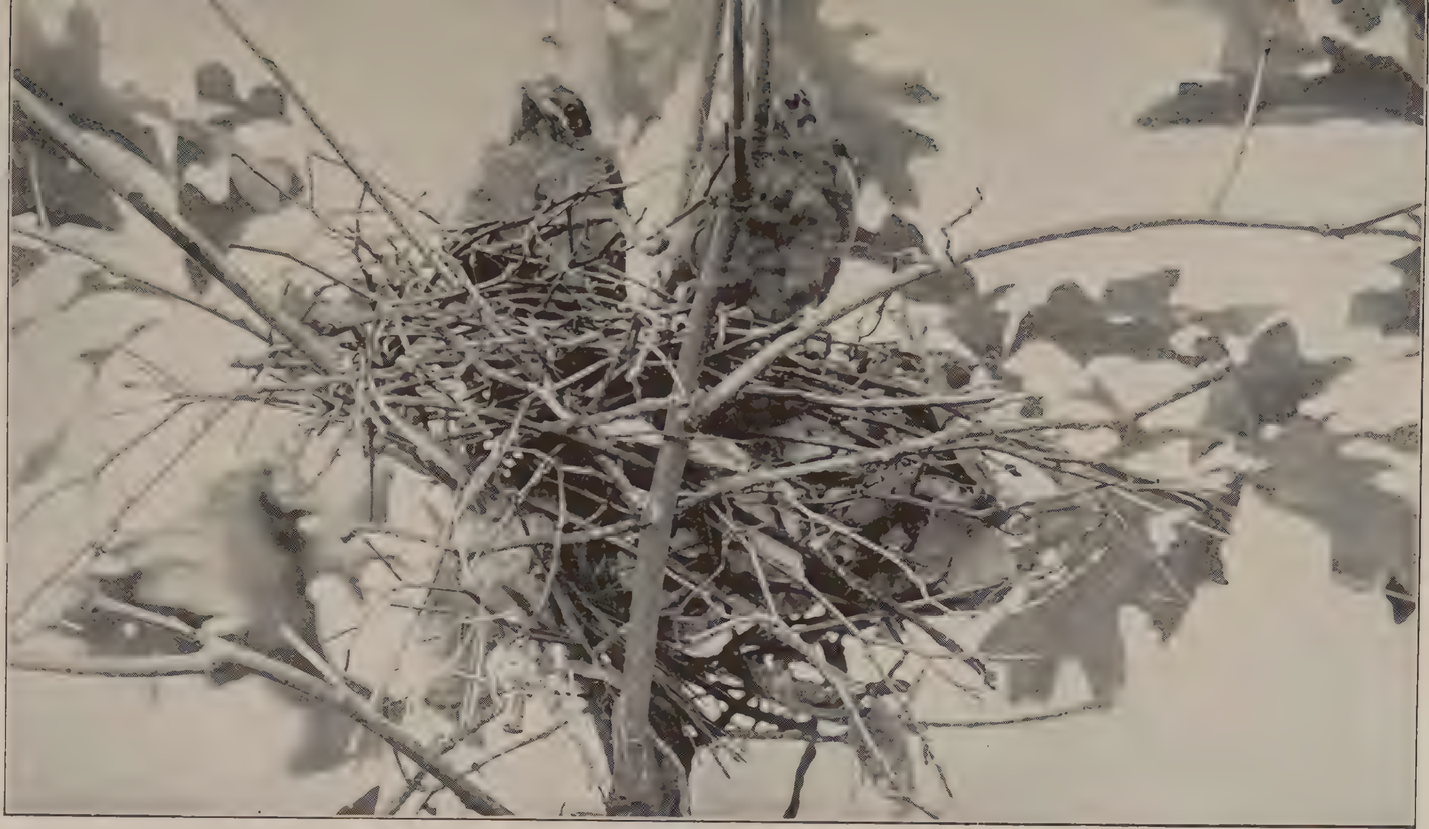

FIG. 82. NEST OF CATBIRD (*Galeoscoptes carolinensis*) CONTAINING TWO YOUNG PREPARED TO LEAVE IT.

Reduced about one-half. From a photograph from life by the Author.

was only two-thirds successful in so far as the fledglings were concerned, for one of their number made good its escape in the high grass near by. Both the others, however, were promptly secured in safety, and together with the fork containing the nest, were shortly afterward carried to my home. Here in due course, sun, wind, and time permitting, I made two or three wonderfully successful photographic pictures of my little prisoners and the nest in which they had been bred and reared.

Two of the best of these results are reproduced in the present connection, and are confidently offered to the reader as fine facsimiles of the originals. Beneath these pictures their legends give nearly all the information that is required in regard to them. In fact they speak for themselves. When we come to take into consideration the fact that a brood of birds had been reared in it, the nest was a wonderfully clean and compact affair, and this is usually the case in this species. Internally this nest was lined with fine black rootlets of some plant, and of a kind, apparently, that is invariably chosen for this purpose by the Catbird. The middle layer of this nest is more or less firm and compact, being composed of a fine grass, good big bits of newspaper and brown paper, of a few pine needles, leaves, and strippings of the fibrous bark of the grapevine. Externally, numerous twigs of various lengths, and from various plants and trees, loosely woven together, complete the structure.

Having secured a photograph to my liking, the inmates were next induced to stand together upon a rather slenderish pine twig, when, by an absolutely instantaneous snap, I secured a life-size picture of the pair at my first trial. (See Fig. 86.)

With care, young Catbirds are easily reared from the nestling stage, and soon become accustomed to a commodious cage. They are good bathers, drink plenty of water, and thrive well upon prepared food, berries in season, and meal worms. One of the best cage pets I ever saw among birds was an individual of this species, raised from the nest, and most assuredly he was a very charming songster. How well Wilson describes what has been the experience of many an ornithologist when he writes:

"In passing through the woods in summer, I have sometimes amused myself with imitating the violent chirping or squeaking of young birds, in order to observe what different species were around me; for such sounds at such a season, in the woods, are no less alarming to the feathered tenants of the bushes than the cry of fire or murder in the streets is to the inhabitants of a large and populous city.

"On such occasions of alarm and consternation, the Catbird is the first to make his appearance; not singly, but sometimes a half dozen at a time, flying from different quarters to the spot. At this time, those who are disposed to play with his feelings may almost throw him into fits, his emotion and agitation are so great at the distressful cries of what he supposes to be his suffering young. Other birds are variously affected, but none show symptoms of such extreme suffering. He hurries backward and forward, with hanging wings and open mouth, calling out louder and faster, and actually screaming with distress, till he appears hoarse with his exertions. He attempts no offensive means, but he bewails—he implores—in the most pathetic terms with which nature has supplied him, and with an agony of feeling which is truly affecting. Every feathered neighbor within hearing hastens to the place, to learn the cause of the alarm, peeping about with looks of consternation and sympathy. But their own powerful parental duties and domestic concerns soon oblige each to withdraw. At any other season the most perfect imitations have no effect whatever on him."

In this last statement the present writer can hardly agree with the learned Wilson, for at this time, the very last days of September, when only a few of the summer stragglers are left in the north, including a handful of Catbirds, I have seen individuals of the latter exhibit not a little curiosity, at least, when I have vigorously imitated the squeaks given vent to by a young bird that has just been seized upon. They will come some little distance to ascertain the cause of the disturbance, and, upon arriving in the neighborhood, will, in a listless manner withal, accompanied by barely audible and querulous notes, and by slow, lateral movements of the tail, give evidence at least of interest in the supposed trouble. But, as Wilson well remarks, identically the same notes produced in the breeding season will drive every Catbird within hearing nearly out of its senses.

At other times this bird possesses a song, and a series of peculiar notes and semi-imitations quite as full of pathos and interest as are those of some of the very best of our avian performers. He has the greatest confidence in man, and if studied in the way he ought to be, exhibits an hundred and one most interesting traits, and a character peculiar to itself, that under all circum-

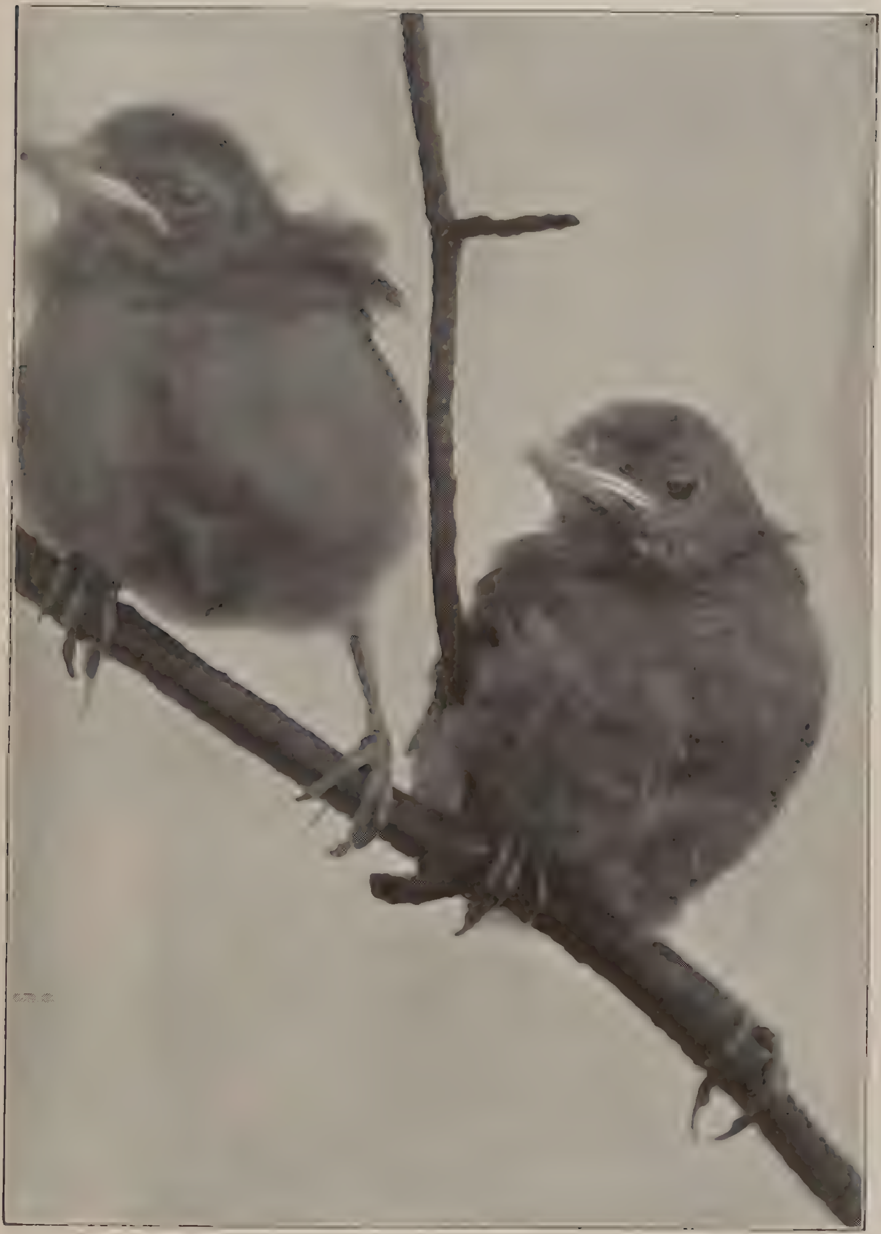

FIG. 86. A PAIR OF YOUNG CATBIRDS.

Life size and the same ones seen in Fig. 85.

From a photograph of the living specimens by the Author.

stances can but charm the true lover of nature and captivate anyone in sympathy with rural life and associations.

Fortunately, this is the case with many, while on the other hand, farmers and farmers' sons have, for over a century past in this country, treated this lovely species with the utmost contempt, prejudice, and persecution. Thousands of the birds have sacrificed their gentle lives and fallen to the guns of these hardened, ignorant, and thoughtless people. Why? Simply because the Catbirds help themselves to a little fruit in season, and the boys are directed to watch the trees and strawberry beds, and shoot all Catbirds on sight.

This is a particularly disagreeable duty, and calculated to foster the aforesaid prejudice, and pass it down from one generation to another. Add to this the farmer's illiberality and the sense of injury at the loss of half a peck of fruit, and the story is complete. Such feelings are never entertained by the generous and broad-minded among us; for notwithstanding the cat-like mewing of this bird, the plainness of its plumage, its marked familiarity—and familiarity, they say, breeds contempt—people thus endowed possess only interest and admiration for the quaint and modest little Quaker among the host of the feathered tribes.

Not far removed from the family *Troglodytidæ* is the family *Mniotiltidæ*, containing our great host of American warblers, and in this group has been placed the genus *Siurus*, containing the Oven-bird and water thrushes. Strictly speaking, we have but one bird in the avifauna of the United States to which the name Oven-bird has been applied, and it likewise has been called the Golden-crowned thrush by some writers, notwithstanding the fact that it has neither a golden crown nor is it a thrush. It gained the name of Oven-bird from the form of nest it builds, although our Dipper of the West *(Cinclus)* likewise constructs an oven nest, with a side entrance, as well as *Siurus*, and the two species are in a way related.

Those who have paid any attention to the birds of eastern North America are perfectly familiar with our Oven-bird, and it has, too, been taken by collectors in Alaska. It comes to us just so soon as spring has thoroughly opened, and it is usually heard a few times before one catches sight of it. As Wilson has said, "It has no song, but a shrill, energetic twitter, formed by the rapid reiteration of two notes, *peche, peche, peche*, for a quarter of a minute at a time."

A little later in the season the number of individuals increases, and there is no trouble in finding them almost anywhere in the heavily shaded parts of the forest, for it is to such localities that the bird confines itself. Most of its time it spends upon the ground, sedately walking—not hopping—about among the dry fallen leaves of the previous year, where it searches for the insects that constitute its principal food. Ever and anon it will fly up into a tree, or into the underbrush, and give vent to its monotonous notes, which may be heard at a considerable distance away. This may be during the very middle of the day, when, as a rule, the notes of all other songsters are hushed, so it can be the more appreciated, relieving as it does the otherwise silent forest. Often, when upon the horizontal branch of a tree, it will walk along it, with lateral movements of its tail, in precisely the same manner as it assumes when upon the ground.

The Oven-bird has an average length of about six inches, with a coloration of plumage that reminds one of some of the smaller thrushes. The top of its head (adult male), has a broad longitudinal stripe of orange-rufous, bounded upon either side by a narrower one of blackish. These latter start from the nostrils, and are carried backward to the neck. Either eye is surrounded by a pale whitish ring, bounded in front by a semicircular one of dusky. A small black stripe likewise bounds the white throat upon either side. Above, the bird is greenish olive, while below it is pure white, with the breast and sides streaked with blackish feathers. Its feet and lower bill are of a pale horn-color, while the superior mandible is darker.

In my son's collection I find a number of specimens of this species collected by him and myself near Washington, D. C., and it is from an adult male of these that I have made the above brief description. We have also taken the young—most restless and nervous little fellows—that I failed to obtain any photographic pictures of, although several attempts were made. Owing to the careful manner in which it is concealed, it is by no means a common occurrence to find a nest of the Oven-bird, and I believe I have never found more than four of them altogether in my life. Near my home in Takoma, however, this spring (1897), my son and I met with a very beautiful example of the nest of *Siurus*, it being situated as usual upon the ground, and on a side hill of gentle slope. It was in the timber-land, composed of scattered poplars, oaks, and chestnuts, with a sparse undergrowth of a variety of shrubs and young trees.

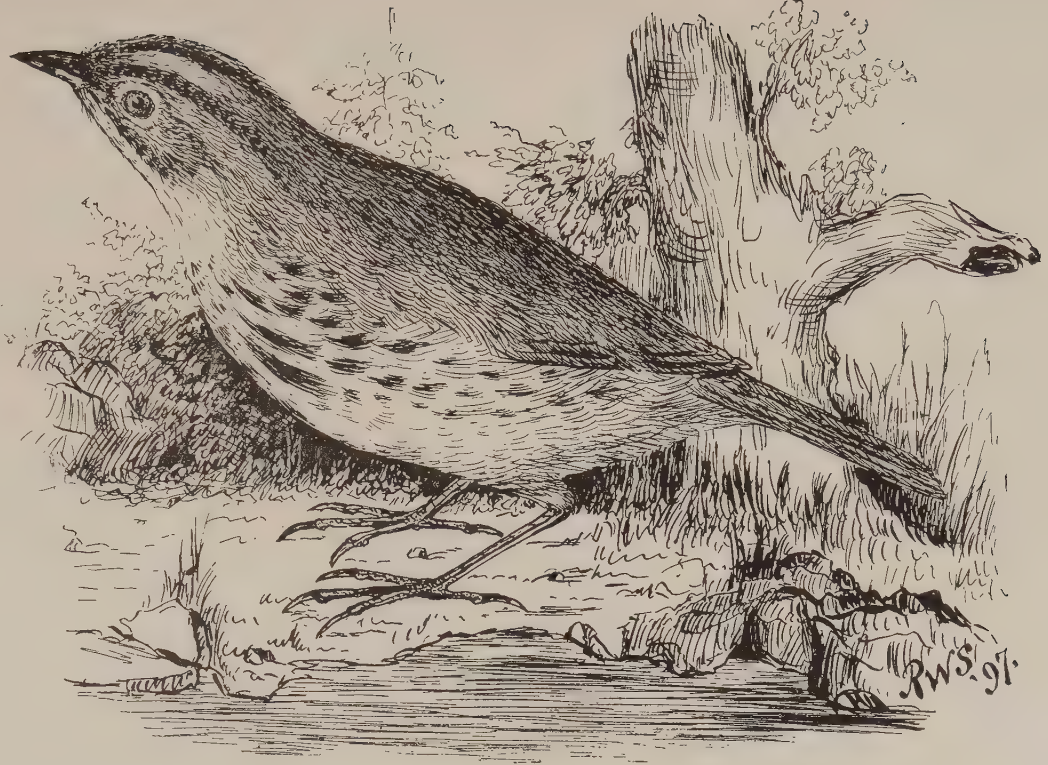

Fig. 87. The Oven-bird (Adult ♂ *Siurus auricapillus*).

Natural size. From a sketch by the Author.

I never knew of but one case where this bird built upon level ground, and where there was not an abundance of dead leaves about. My observations, however, have been confined to New England, and south to southern Maryland. Then, too, the side entrance to this nest faced nearly north, while, I am given to understand, they usually build so as to have this opening face the south.

The presence of the nest was first suspected by my son, by his seeing the female spring up suddenly only a foot or so in front of him, and run like a mouse over the ground and then disappear in the underbrush. After a search of several minutes I found the nest, and it certainly was one of the most skillfully concealed structures of the kind one could imagine. Built flush with the level of the ground, the nest itself was composed of dry leaves, fine dry grass, a few pine needles, and sparsely lined with horsehair. Dry leaves and fine dry grass were also used to construct a dome that completely arched over the nest proper, the former having been built around the stem of a small maple about a foot high, that had every appearance of having sprouted out of the top of the arch. But what made the deception still more perfect was the fact that the entire affair was built beneath some large chestnut leaves and pine needles, that still remained attached to some small dead limbs on the ground. In short, the whole nest with its dome was in complete harmony with the little low plants, moss, dead leaves, and twigs that surrounded it all about. It contained five eggs, almost incubated. These were nearly uniform both in size and color; one of them I find measuring about .80 by .60, being white and meagerly speckled over with pale reddish brown, but chiefly in a broad, well-defined band near the larger end. A few large lilac spots are also to be seen, but chiefly in the aforesaid bands.

One afternoon about 3 o'clock, several days afterward, I took my camera over to the spot, and succeeded in getting a photograph of this nest *in situ*, and the picture is reproduced in Fig. 88.

Wilson, in speaking of this bird, says: "When alarmed, it escapes from the nest with great silence and rapidly running along the ground like a mouse, as if afraid to tread too heavily on the leaves; if you stop to examine its nest it also stops, droops its wings, flutters and tumbles along, as if hardly able to crawl, looking back now and then to see whether you are taking notice of it. If you slowly follow, it leads you fifty or sixty yards off, in a direct line from its nest, seeming at every advance to be gaining fresh strength; and when it thinks it has decoyed you to a sufficient distance, it suddenly wheels off and disappears."

The bird practiced no such deception in our case. Wilson also states that the Cow bird frequently selects the nest of *Siurus* in which to deposit its egg, "and leaves the result to the mercy and management of the Thrush, who generally performs the part of a faithful and affectionate nurse to the foundling."

Swainson, the well-known naturalist, is responsible for the name of this genus *(Phil. Mag. I*, May, 1827), and he wrote it *Seirus*, from two Greek words, signifying to wave or wag the tail; but as Newton has pointed out, the more correct spelling is *Siurus*, and this has been adopted here.

In this country the genus likewise contains the Water-Thrush *(S. noveboracensis)*, Grinnell's water-thrush *(S. n. notabilis)*, and the Louisiana water-Thrush *(S. motacilla)*. In the classification adopted in the A. O. U. Check-List this genus is placed between two genera of warblers, where it by no means belongs. As I have said, it comes much nearer the American dipper *(Cinclus)*, the pipits *(Anthus)*, and the true wagtails *(Motacilla)*. This was pointed out by me many years ago, when I examined the skeletal structure of *Siurus (Bull. Nutt. Ornitho. Club*, VII, No. 4, October, 1882).

In England there are a number of birds locally called oven-birds, but the name is applied more particularly to the Willow-wren, which, as in the case of the others, all build dome nests.

But none of these birds, nor, for the matter of that, our own *Siurus auricapillus*, are to be considered the true Oven-bird, as strictly considered by ornithologists; for properly speaking, it should be applied only to those South American species which the genus *Furnarius* was created to contain. *F. rufus* is perhaps the best known form of all these, and among the Spanish-speaking people of that country it is known as the Hornero (Baker), and also as the Casara. This bird I have never had the opportunity of studying in its native haunts, but long ago, Darwin, in his famous *Voyage of a Naturalist*, wrote of it, and said:

"The genus *Furnarius* contains several species, all small birds, living on the ground and inhabiting open, dry countries. In structure they cannot be compared to any European form. Ornithologists have generally included them among the creepers, although opposed to that family in every habit. The best known

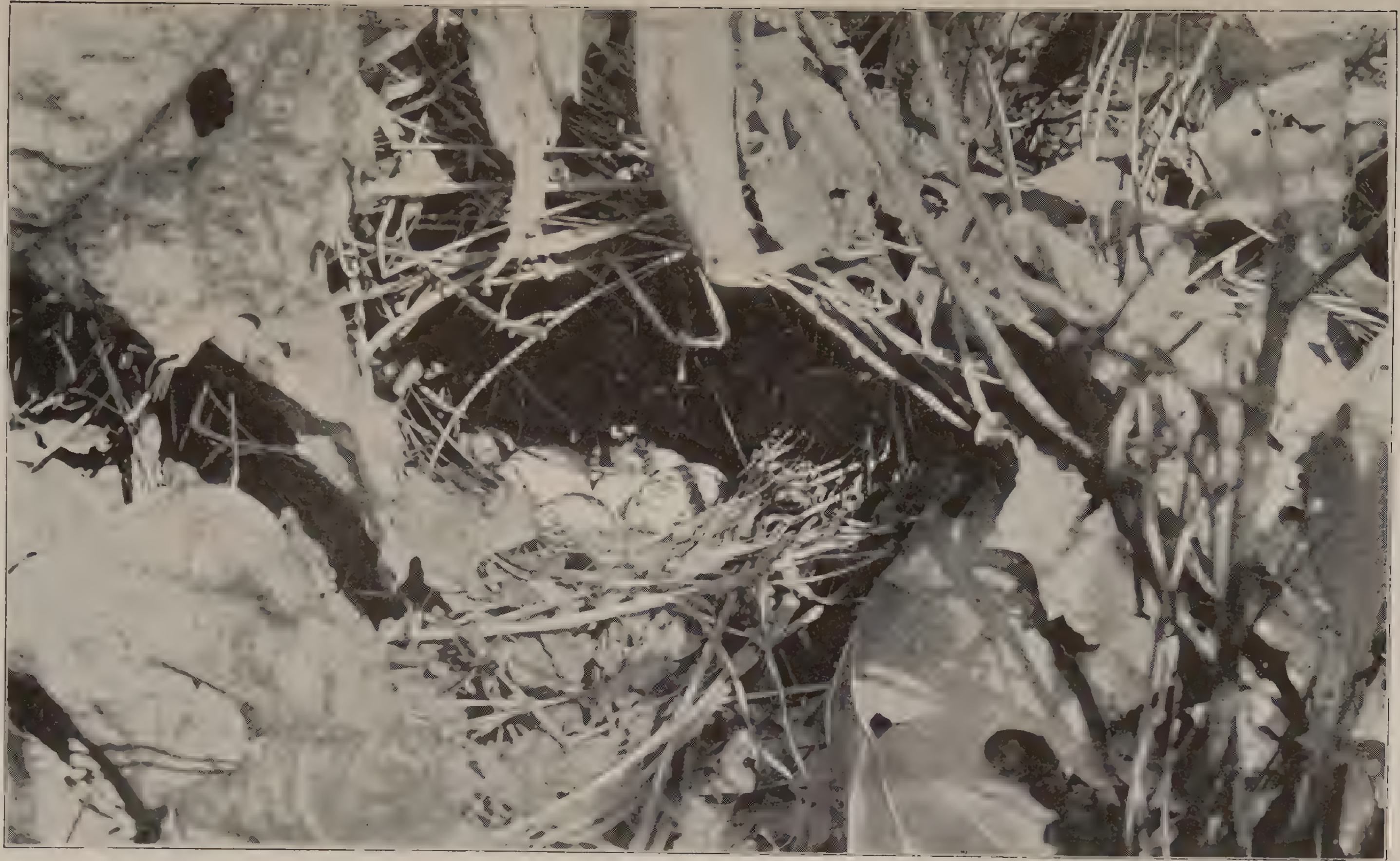

FIG. 88. NEST OF THE OVEN-BIRD (*Siurus auricapillus*).

Photographed *in situ*, natural size, by the Author.

species is the common Oven-bird of La Plata, the Casara, or housemaker, of the Spaniards. The nest, whence it takes its name, is placed in the most exposed situations; as on the top of a post, a bare rock, or on a cactus. It is composed of mud and bits of straw, and has strong, thick walls; in shape it precisely resembles an oven, or depressed beehive. The opening is large and arched, and directly in front; within the nest there is a partition, which reaches nearly to the roof, thus forming a passage or antechamber to the true nest." (Vol. I, pp. 121, 122).

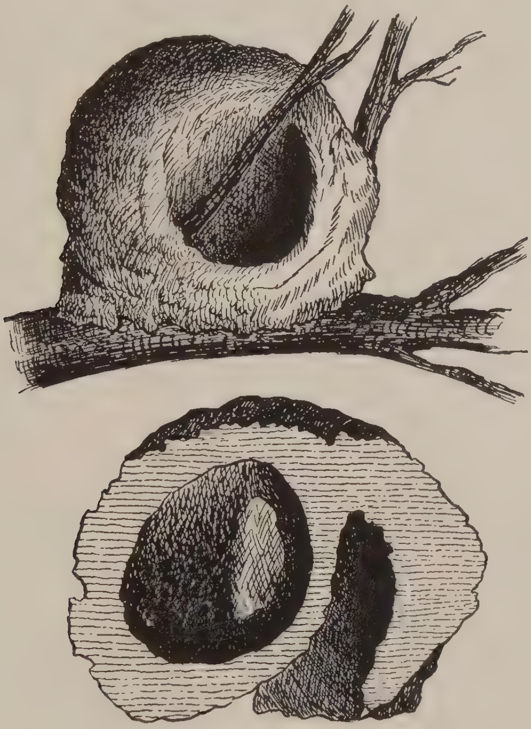

FIG. 89. (Upper figure) NEST OF OVEN-BIRD (*Furnarius*).

FIG. 90. (Lower figure) VERTICAL SECTION OF THE SAME NEST OF OVEN-BIRD SHOWN IN FIG. 89.

Both drawings by the Author, after Newton.

In Part III of Newton's *Dictionary of Birds* at pages 669 and 670, I find two excellent drawings of the nest of *Furnarius rufus*, and of these I have personally made careful copies, exhibiting them in the present connection in Figs. 89 and 90:

"Another and smaller species of *Farnarius (F. cunicularius)*," says Darwin, in continuation of what I have quoted above, "resembles the Oven-bird in the general reddish tint of its plumage, in a peculiar shrill, reiterated cry, and an odd manner of running by starts. From its affinity, the Spaniards call it Casarita (or little housebuilder), although its modification is quite different. The Casarita builds its nest at the bottom of a narrow cylindrical hole, which is said to extend horizontally to nearly six feet under ground. Several of the country people told me that when boys they had attempted to dig out the nest, but had scarcely ever succeeded in getting to the end of the passage. The bird chooses any low bank of firm, sandy soil by the side of a road or stream. Here (at Bahia Blanca) the walls round the houses are built of hardened mud, and I noticed that one, which inclosed a courtyard where I lodged, was bored through by round holes in a score of places. On asking the owner the cause of this, he bitterly complained of the little Casarita, several of which I afterward observed at work. It is rather curious to find how incapable these birds must be of acquiring any notion of thickness, for although they were constantly flitting over the low wall, they continued vainly to bore through it, thinking it an excellent bank for their nests. I do not doubt that each bird, as often as it came to daylight on the opposite side, was greatly surprised at the marvelous fact."

One can easily imagine how much an instance of this nature must have interested Mr. Darwin, who was so constantly employed in search of facts to illustrate the various grades of reason as exemplified in all kinds of animals.

Numerous other naturalists besides Darwin have written about these wonderfully interesting oven-birds of South America, and special reference may be made to the works of Durnford, Hudson, Gibson, Burmeister, and Dorbigny. Each or any of these may be read with profit and interest. As Professor Newton tells us, however, the figures of the nests of *Furnarius* are, as a rule, very poor indeed; that is, apart from the one here reproduced, which was presented to the Cambridge Museum, of England, by Mr. J. Young.

In concluding this chapter I am prompted to say I hope it will at least have the effect of inciting its readers who, either professionally or otherwise, may be naturalists, to study more closely the habits of our common birds. It is a marvel to me sometimes how very imperfect our knowledge is in such matters. I have found ornithologists of repute who will aver that "our Oven-bird never builds except upon a sidehill"; the entrance to its nest "always faces south," and that the bird by structure is nothing more nor less than a big American warbler—and so on. Frequent and carefully recorded observations are the only methods known to me by means of which such myths as these may be dissipated, and the truth introduced in their place.

CHAPTER XXIV.

THE COMMON OPOSSUM AND ITS KIN.

(Didelphys virginiana.)

THE Common Opossum stands the lowest in point of development of all the members representing the mammalian fauna of the United States; therefore in any list of mammals of this country, presented in linear series, the Opossums are given first, in order to indicate this fact. Belonging, however, as they do to the marsupial group of animals, the opossums are in another sense the most typically *mammalian* of all the class Mammalia. The reason assigned for this is, that in them respiration, as performed by the lungs, and the maternal secretion of milk appear earlier and thus antedate all other modes in supplying the requisite amount of oxygen and nutriment for the development of the young. As in other marsupials the presence of the mammary glands in this group, and the healthy operation of their milk-secreting function is absolutely essential to the perpetuation of the species. Taken as an order the marsupial animals are confined to the American continent and to the Australian region, and although in their external forms and internal structure they exhibit very notable diversity, yet for the sake of convenience naturalists continue to thus group them as the Marsupialia. As thus restricted they constitute the subclass (of the class Mammalia) termed the *Metatheria* or *Didelphia*.

Opossums, or the family *Didelphidæ*, are peculiar to the continent of America, not now being found in any other part of the world, though they there formerly existed, as fossil remains of them have been found in the Eocene and early Miocene periods of Europe.

Mr. Oldfield Thomas, of the British Museum, a great authority upon mammals, says of the existing forms that "opossums are small animals, varying from the size of a mouse to that of a large cat, with long noses, ears, and tails, the latter being, as a rule, naked and prehensile, and with great toes so fully opposable to the other digits as to constitute a functionally perfect posterior pair of 'hands.' These opposable great toes are without nail or claw, but their tips are expanded into broad, flat pads,

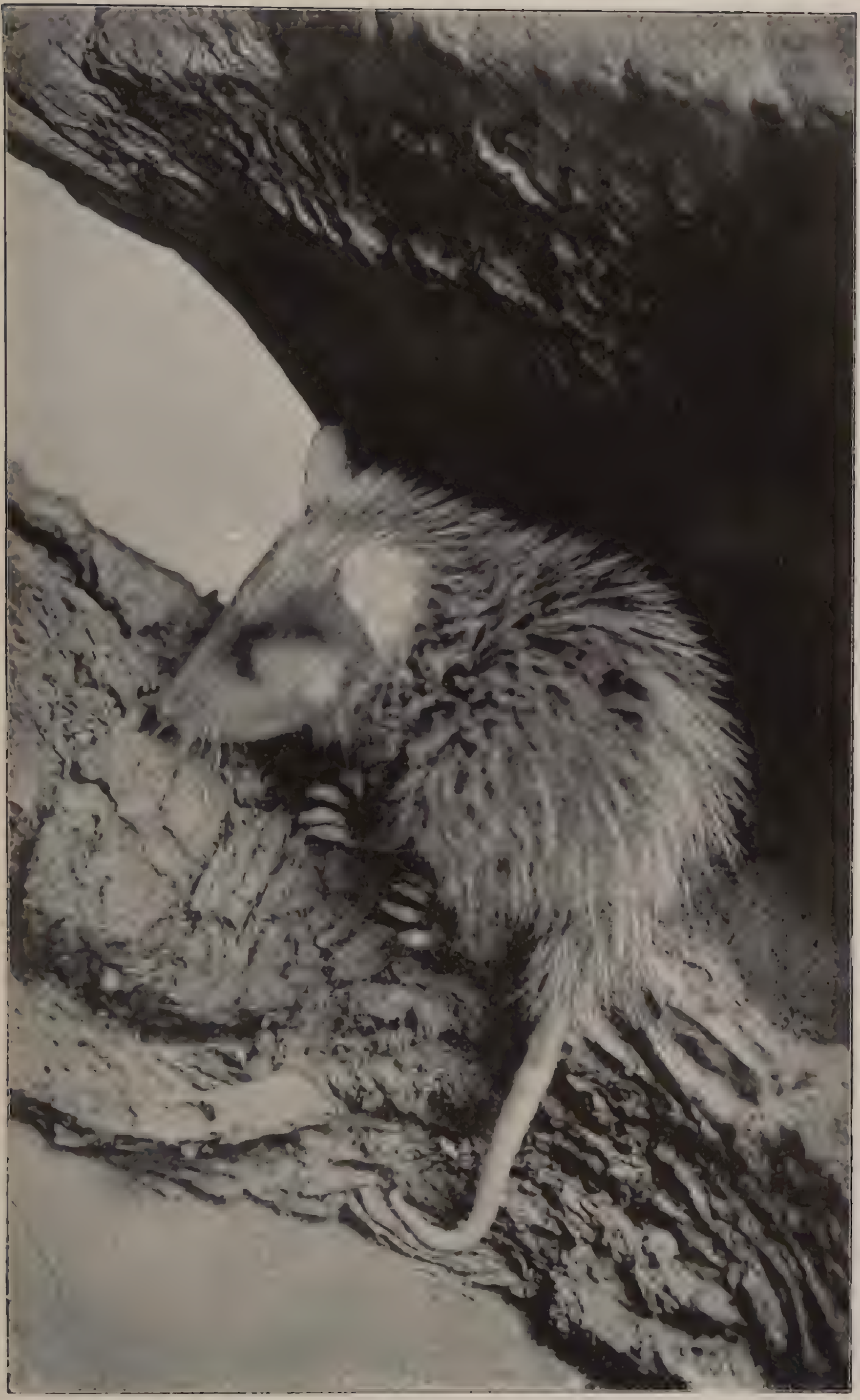

FIG. 91. YOUNG OF AMERICAN OPOSSUM (*D. virginiana*).

Natural size; about two months old. Photograph from life by the Author.

which are, no doubt, of the greatest use to such a climbing animal as an opossum. On the anterior limbs all the five digits are provided with long sharp claws, and the pollex or thumb is but little opposable. Their numerous teeth are covered with minute sharply pointed cusps, with which to crush the insects on which they feed, for the opossums seem to take in South America the place in the economy of nature filled in other countries by the true *Insectivora*, the hedgehogs, moles, and shrews.

"The family consists of two well-recognized genera only, viz., *Didelphys*, containing all the members of the family, with the exception of the Tapock, a curious animal which forms by itself the second genus, *Chironectes*, and is distinguished from all other opossums by its webbed feet, non-tuberculated soles, and peculiar coloration. Its ground color is light gray, with four or five sharply contrasted brown bands passing across its head and back, giving it a very peculiar mottled appearance. It is almost wholly aquatic in its habits, living on small fish, crustaceans, and other water animals; its range extends from Guatemala to southern Brazil."

As has already been stated above, the genus *Didelphys* contains all the other forms of opossums, and a very heterogeneous collection they are; *D. virginiana* or our common Virginia or American opossum being by far the best known representative of the genus. This genus *Didelphys* could doubtless with truth and propriety be split up into several well-defined genera, each possessing good generic characters. For example, some of the species of opossums are large-sized ones, like our United States form, with coarse, long, dark-colored pelage, big leafy ears, completely developed marsupial pouches, and with distinguishing internal anatomical characters. The Crab-Eating opossum *(D. cancrivora)* of South and Central America, is another well-known type of this group, and not very unlike the American opossum.

"The second group, or subgenus, named *Metachirus*," as remarked by Thomas, "contains a considerable number of species found all over the tropical parts of the New World. They are of medium size, with short, close fur, very long, scaly, and naked tails, and have less developed ridges on their skulls. They have, as a rule, no pouches in which to carry their young, and the latter therefore commonly ride on their mother's back, holding on by winding their prehensile tails round hers." The Lord Derby's

Opossum *(D. derbiana)* typifies this group, the third one having been named *Micoureus* (or *Grymœomys* of Burmeister), it "differing only from *Metachirus* by the comparatively smaller size of its members and by certain slight differences in the shape of their teeth. Its best known species is the Murine opossum *(D. murina)*, no larger than a house-mouse, of a bright-red color, which is found as far north as central Mexico, and extends thence right down to the south of Brazil. The last subgenus contains three or four wonderfully shrew-like species, of very small size, with short, hairy, and non-prehensile tails, not half the length of the trunk, and with wholly unridged skulls. The most striking member of this group is the Three-striped opossum *(D. tristriata)*, from Brazil, which is of a reddish-gray color, with three clearly defined deep-black bands down its back, very much as in some of the striped mice of Africa. This subgenus has been named *Hemiurus* or "half-tail" by Geoffroy Saint-Hilaire *(Microdelphys* of Burmeister), and should perhaps be allowed full generic rank."

Very considerable attention has been paid to the anatomy of the *Didelphyidæ*, and some of this is from the pens of American writers; still the subject has by no means been exhausted, and good contributions to it are still in order, and will be highly appreciated by science, come from what quarter they may. Especially is it to be desired that the morphology of the young of this family be thoroughly worked out, giving the various stages of development from the time of conception to the time of subadult life.

In speaking in a general way of the anatomy of the Marsupialia, Sir William Henry Flower, now in charge of the Natural History Departments of the British Museum, has said the "mammæ vary much in number, but are always abdominal in position, have long teats, and in most of the species are more or less enclosed in a fold of the integument, forming a pouch or marsupium, though in some this is entirely wanting, and the newly-born, blind, naked, and helpless young, attached by their mouths to the teat, are merely concealed and protected by the hairy covering of the mother's abdomen. In this stage of their existence they are fed by milk injected into their stomach by the contraction of the muscles covering the mammary gland, the respiratory organs being modified temporarily, much as they are permanently in the *Cetacea*,—the elongated upper part of the larynx projecting into the posterior nares, and so maintaining a free communication between the lungs and the external surface independently of the mouth and gullet, thus averting the danger of suffocation while the milk is passing down the latter passage."

Our American opossum is chiefly found in the southern and southwestern States, as far north as New Jersey and Pennsylvania. It has also been found, I believe, in California, and they are very abundant all over the State of Virginia, and, during the proper season, a great many of them are exposed for sale, ready dressed, in the markets of Washington, D. C.

A year or more ago I was greatly indebted to Professor W. P. Hay, who has charge of the biological department of the Central High School of Washington, D. C., for the loan of an old female opossum *(D. virginiana)* with her brood of young ones. To the best of my recollection there were nine of these latter originally, but when I received the animal she had only seven, they all having been born about two months previous, and two had died quite early in the career of the family. A large box was prepared for her as a temporary habitation, one side of it being covered by a coarse wire netting, and the bottom made comfortable by a generous layer of coarse sawdust.

She fed somewhat sparingly upon raw flesh of various kinds, and would drink about a pint of milk in the course of twenty-four hours, her feeding being generally done at night. She did not appear to be very solicitous of her young, and made barely any resistance when one picked them up to be examined. Frequently she would roll up partially into a ball, and then when a young one was taken away from her she simply gave vent to a kind of gutteral hiss, accompanied by a sluggish grin.

Shortly after coming into my possession, she, through carelessness, I believe, killed another one of her brood, while one or two more fell into the water or milk and were drowned; she meanwhile not seeming to care very much, nor did she, apparently, make any attempt to rescue them from their fate. Her young ones, when fully as large as small rats, would nurse her many times a day, sometimes three or four of them attaching themselves to her teats at once; sprawling over each other, being in her pouch, partially in it, or just having the head within the hairy margins of the entrance.

I found these young opossums extremely difficult subjects to get good photographs of, from the fact that they were so restless when taken away from their mother. They were not sprightly at all, but simply kept sluggishly on the move; first gaping, then twitching their ears or curling up their tails, and finally, when kept away too long, they would commence to shiver all over. However, I succeeded at last, after many trials, and reproductions of two of my attempts are presented as illustrations to the present chapter.

If there be such a thing in nature as "a chip of the old block," then we most assuredly find it in a young opossum, for any one of these little fellows was the veriest chip alive of its sleepy old dame. It would walk along a twig, holding on in the same curious manner with its hand-like feet, just as the mother progressed upon a larger branch; while thus engaged, its little prehensile tail also came into use, and it would curl its delicate distal end about the twig in a gingerly sort of way, with some evident infantile misgivings that it could be much relied upon in event its tiny feet became exhausted from the task.

During the daytime they were almost continually gaping, and made up a most ludicrous face when they did, that was sure to excite the laughter of those that beheld it, even after a number of repetitions.

Their marsupial pouches at this age are quite rudimentary, but still perfectly evident, while the bushy extension of the hair at the root of the tail is distinctly seen. The hair of the body is long and coarse, being much shorter and finer upon the head, while upon the rather large white ears it is sparse and extremely fine. Long white hairs are produced from either side of the snout and from above either eye, the latter being round, not large, black, and twinkling. The mouth has a capacious gape, and the entire face and snout are pointed, as in the old one. By the use of tail and feet these young opossums are enabled to hang on to the coat of the mother, and when they all got into the hair of her back they presented a very odd and amusing picture, to say nothing of the enjoyment they exhibited, howbeit it was shown in such a sleepy way.

A popular writer and observer at my hand says an old opossum of this species "is very prolific, producing from six to fifteen at a birth. The young at this period are well formed, and weigh from three to four grains each. As soon as produced they are shoved into the pouch by the mother with her snout, and pushed near the nipples, which they find and grasp by instinct. Their growth is very rapid; at a week old they weigh thirty grains. They remain in the pouch, attached to the nipple, till they are able to move about. At the age of four weeks they occasionally leave the nipple, and may be seen peeping out of their sack; a week afterward they venture forth, but keep close to the mother, and hold on to her by their tails. Sometimes, with a dozen young ones of the size of rats thus clinging around her legs, neck, and body, and some of them dragging along on the ground, she may be seen going about in search of food. At this age these animals are pretty. They remain with the mother till about two months old; they then learn to take care of themselves, but continue in the vicinity, seeming still to be under maternal guardianship in a certain degree. Meantime another brood is produced, and during the season a third, and some of all these may be seen at once with their prolific parent."

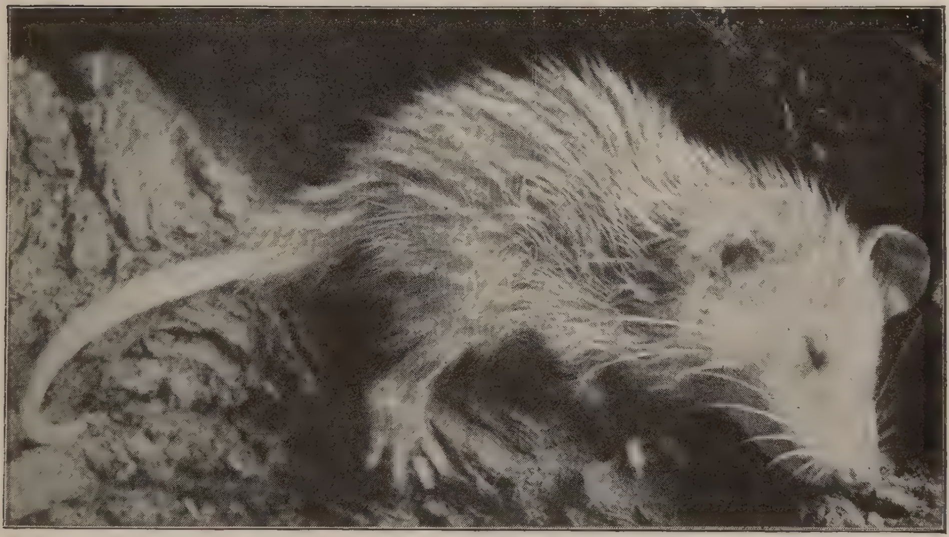

Fig. 92. Young of American Opossum (*D. virginiana*).
Natural size; about two months old; right lateral view of the same specimen shown in Fig. 88. Photograph from life by the Author.

Some of the Australian marsupials have been called there "opossums" by the settlers, but, as has already been stated, there are no true opossums in Australia. That great continent, however, is the headquarters for the order, and many of the remarkable kin of our common Opossum in this country are to be met with there.

Taken as a group, naturalists find that the marsupials readily fall into six very natural families, the divisions being based chiefly upon dental and other anatomical characters.

Following the *Didelphidæ*, we have the *Dasyuridæ*, represented by the famous Thylacine, better known as the Tasmanian Wolf or Devil, or Zebra Wolf or Zebra Opossum *(Thylacinus cyanocephalus)*, the only species of the genus known. It is a dog-like looking animal confined now to the island of Tasmania, and the largest marsupial of predaceous habit now in existence. The conspicuous transverse bars on its back and loins constitute a marked character, the general color being grayish-brown.

Rapid extermination now seems to be this animal's fate, and the savage havoc it formerly committed among the sheep of the Tasmanian settlers, is now largely an early chapter in its life-history. Another voracious animal confined to the same country and belonging to the same family is the "Native Devil," a creature about the size of a badger, and likewise with fossorial habits. *(D. ursinus)*.

Related forms are found in Australia, and in New Guinea, where likewise occur the peculiar rat-like marsupials of the genus *Phascogale*, and perhaps the still more remarkable *Myrmecobius*, of which latter only one species is known, the *M. fasciatus* of western and southern Australia. "It is about the size of an English squirrel, to which animal its long bushy tail gives it some resemblance; but it lives entirely on the ground, especially in sterile, sandy districts, feeding on ants. Its prevailing color is chestnut-red, but the hinder part of the back is elegantly marked with broad, white, transverse bands on a dark ground." (Flower.)

In the family *Peramelidæ* we also find some of the most remarkable and remote kin of our American opossum. Recently some very interesting anatomical developments have come to light in regard to animals of this group, giving them an importance in the study of the law of evolution not previously seen in them. Various species make up the genera, and in Australia they are widely known by the names of "Bandicoots" *(Perameles)*, "Native Rabbits" *(Macrotis)*; and in the case of the peculiar little *Chœropus castanotis*,—the "Pig-footed Bandicoot."

Other famous marsupials are all the forms of kangaroos of the family *Macropodidæ*, as well as the remarkable animals constituting the family *Phalangistidæ*, and the family *Phascolomyidæ*, but these are only referred to in order to show what a great variety of relatives our common United States Opossum has in those far-off regions; howbeit, it must not be forgotten that although the marsupial family *Didelphidæ* are thus related, the gap sometimes separating them is quite profound, as for example, the one that divides the *Didelphidæ* from the *Peramelidæ*. In other words, an American Opossum and a Bandicoot *(P. gunnii)* are two wonderfully different animals, and in the future, the more we know of their anatomy, the more will this fact come to be appreciated.

The fossil bones of opossums found in the bone-caves of Brazil, belonged to types of didelphian species either identical with or closely allied to those forms now existing in the same country.

CHAPTER XXV.

WHALES AND MANATEES.

(Cetacea: Sirenia.)

OWING to the enormous extent of coast-line belonging to the United States, washed as it is by the Arctic Seas, the Atlantic and Pacific Oceans, and the Gulf of Mexico, it permits of adding to the fauna of the country many of the order *Cetacea*, or those marine mammals known as whales, dolphins, and porpoises. Outside of the few who have especially studied these great oceanic animals, of more or less fish-like form, it is but a limited number who realize how numerous are the species we can lay claim to as having occurred some time or other upon our coasts.

Some years ago the United States National Museum of Washington, D. C., published a provisional list of these highly interesting mammals, and this I here present, simply in order to give some idea of what an extensive group the *Cetacea* really is:

ORDER CETACEA. CETACEANS.

SUBORDER DENTICETE. TOOTHED WHALES.

Family PHYSETERIDÆ. *The Sperm Whales.*

Sotalia pallida, Gervais. Florida (?).

? *Steno fuscus*, Gray. Cuba.

Steno compressus, Gray. Gulf of Mexico (?).

Delphinus bairdii, Dall. Baird's Dolphin. Coast of California.

Delphinus delphis, Linné. Common Dolphin. Atlantic Ocean.

Delphinus janira, Gray. The Janira. Newfoundland (Gray).

? *Prodelphinus euphrosyne* (Gray), True. North Atlantic Ocean.

Leucorhamphus borealis (Peale), Gill. Right-whale Porpoise. Pacific coast of North America.

Lagenorhynchus acutus, Gray. Eschricht's Dolphin. North Atlantic Ocean.

Lagenorhynchus albirostris, Gray. White-beaked Bottlenose. North Atlantic Ocean.

Lagenorhynchus obliquidens, Gill. Striped or Common Dolphin. Pacific coast of the United States.

Lagenorhynchus thicolea, Gray. West coast of North America.

Lagenorhynchus gubenator, Cope. Skunk Porpoise. Coast of New England.

Lagenorhynchus perspicillatus, Cope. Atlantic coast of the United States.

Tursiops tursio (Bonnaterre), Van Ben. & Gervais. Bottle-nosed Dolphin. North Atlantic Ocean.

Tursiops gillii, Dall. Cowfish. Pacific coast of the United States.

Tursiops erebennus, (Cope) Gill. Black Dolphin. Atlantic coast of the United States.

Orca gladiator, (Bonnaterre) Gray. Atlantic Killer. Atlantic Ocean.

Orca atra, Cope. Pacific Killer. Pacific coast of North America.

Orca pacifica, (Gray). North Pacific Ocean. (?)

Globiocephalus melas, (Traill). Blackfish. North Atlantic Ocean.

Globiocephalus brachypterus, Cope. Short-finned Blackfish. Coast of New Jersey.

Globiocephalus scammoni, (Cope). Scammon's Blackfish. Pacific coast of North America and southward.

Grampus griseus, (Cuvier) Gray. Grampus. North Atlantic Ocean.

Grampus stearnsii, Dall. Mottled or White-headed Grampus. Pacific coast of North America.

Delphinapterus catodon, (Linné) Gill. White Whale. Arctic and Subarctic seas.

Monodon monoceros, Linné. Narwhal. Arctic seas.

Phocœna cummunis, Lesson. Puffing-Pig. Herring-Hog. North Atlantic Ocean.

Phocœna lineata, Cope. Striped Porpoise. Atlantic coast of the United States.

Phocœna vomerina, Gill. California Bay Porpoise. Pacific coast of the United States.

Family ZIPHIIDÆ. *Bottle-nose Whales.*

Berardius bairdii, Stejneger. Baird's Whale. Bering Island.

Hyperoodon rostratus, (Chemnitz) Wesmael. Bottle-nose Whale. North Atlantic Ocean.

Ziphius cavirostris, Cuvier. Temperate and tropical seas.

? *Ziphius semijunctus*, (Cope). Atlantic Ocean.

Ziphius grebnitzkii, Stejneger. Grebnitzky's Bottle-nose Whale. Bering Island.

Mesoplodon sowerbiensis, Gervais. Sowerby's Whale. Temperate North Atlantic.

Family PHYSETERIDAE. *The Sperm Whales.*

Physeter macrocephalus, Linné. Sperm Whale. Temperate and tropical seas.

Kogia breviceps, (De Blainville) Gray. Pygmy Sperm Whale. Temperate and tropical seas.

SUBORDER MYSTICETE. WHALEBONE WHALES.

Family BALAENIDAE.

Rhachianectes glaucus, Cope. Devil-fish. Gray Whale. Pacific coast of North America.

Agaphelus gibbosus, Cope. (?) Scragg Whale. North Atlantic.

Megaptera longimana (Rud.), Gray. Humpback Whale. North Atlantic Ocean.

Megaptera bellicosa, Cope. Caribbean Humpback Whale. Caribbean Sea.

Megaptera versabilis, Cope. Humpback Whale. North Pacific Ocean.

Physalus antiquorum, (Fischer) Gray. Finback Whale; Razorback. North Atlantic Ocean.

Physalus sibbaldii, Gray. North Atlantic Ocean.

Balænoptera rostratus, (Muller) Gray. Piked Whale (? Grampus of New England Fishermen). North Atlantic Ocean.

Balænoptera davidsoni, Scammon. Finback Whale. Northeastern Pacific Ocean.

Sibbaldius laticeps, Gray. Rudolphi's Rorqual. North Atlantic Ocean.

Sibbaldius tuberosus, Cope. Mobjack Bay, Virginia.

Sibbaldius veliferus, (Cope). Finback Whale. Pacific Coast of North America.

Sibbaldius tectirostris, Cope. Coast of Maryland.

Sibbaldius sulfureus, Cope. Sulphur-bottom Whale. Pacific coast of North America.

Balæna japonica, Gray. Right Whale of North Pacific. North Pacific Ocean.

Balæna biscayensis, Gray. Black Whale; Right Whale of the North Atlantic. Temperate North Atlantic.

Balœna mysticetus, Linné. Bowhead Whale. Arctic Seas.

It will be observed of the species enumerated in this formidable list, that the vast majority of them actually do occur in our own waters, but this fact obviously prevents me from doing more in the present chapter than giving some of the general characters and habits of cetaceans, with very brief notice of the more interesting and important forms. It would require a large volume alone to do full justice to all the species given in the above list.

So far as geology up to the present time has been enabled to indicate it for us, we are obliged to confess that the ancestry of the Cetacean in past ages is still involved in much obscurity. Huge serpent-like forms *(Zenglodon)* have been found in the fossil state in certain parts of Alabama, which for a long time were considered as being in the cetacean line of descent, but more recent investigation seems to point to the fact that the seals have a better claim upon those ancient forms than the whales have. In other parts of the world fossil forms have been discovered which have helped us to a better solution, but, as I say, we are still a long ways from being in possession of an exact knowledge of the origin of this group, as we are in the case of many other animals. One thing, however, must be borne fully in mind, and that is, the Whales are just as truly mammalian in all respects, as are such animals as seals, pigs, or bears. Indeed, they are nothing more nor less than monster marine mammals that have become specially modified in time to lead strictly an aquatic life in recent epochs.

The general external characters of Whales can be readily appreciated from the figures of the species illustrating this chapter; the fish-like form is to be noted, with the enormous head in some of the species, and with the total absence of anything like unto a neck in all the forms; the peculiar pattern of the horizontally placed tail with its diverging, lateral "flukes," posteriorly divided by the median notch; the form of the anterior paddles, and the entire absence of a hinder pair; that a few of the species may have a showing of scattered hairs on the body, more especially near the mouth; the small eyes, the simple aperture of the ears, the valvular openings of the nostrils situated on top of the head; and a number of other points. Whales also possess immediately beneath the skin a thick layer of fat known as the "blubber," from which the oil is manufactured, and for which men hunt and capture them. As in the case of the topographical anatomy, the internal structure of these ponderous creatures is highly interesting and instructive, but our space will admit of none of it here. But it will be proper to note, however, that, with but few exceptions, all Whales have teeth, and that these vary greatly in number; never being preceded by a milk set, while in the adult right whales in which family the teeth are absent, the well-known whalebone is seen (baleen). It would be as well to remark, too, that the mammæ in the female Whales are situated on either side of the genital fissure, being two in number, and each being under the control of a special compressor muscle by means of which the milk of the mother can be injected into the mouth of her young one (there being rarely two), and the latter is thus enabled to nurse under water.

Whales of all species subsist on animal food of some kind or other, such as for example, fish, squids, crustaceans, and the medusæ. The Killers *(Orca)* alone prey upon the species of their own order, and upon such other warm-blooded animals as seals and their kind.

During a year that I spent at sea in the Gulf of Mexico and the South Atlantic, I had many opportunities to observe the various kinds of whales and porpoises, which I availed myself of to the fullest extent, and have seen an old Sperm whale blow many and many a time. Professor Flower well describes this act and according to this eminent authority, when speaking of what a helpless creature a whale is on shore, he says that when in their element, the sea, " they have, however, to rise very frequently to the surface for the purpose of respiration; and, in relation to the constant upward and downward movement in the water thus necessitated, their principal instrument of motion, the tail, is expanded horizontally, quite unlike that of a fish, whose movements are mainly in straightforward or lateral directions. The position of the respiratory orifice or nostril on the highest part of the head is very important for this mode of life, as it is the only part of the body the exposure of which above the surface is absolutely necessary. Of the numerous erroneous ideas connected with natural history, few are so widespread and still so firmly believed, notwithstanding repeated expositions of its falsity, as that the *Cetacea* spout out through their blowholes water taken in at the mouth. The fact is, the 'spouting,' or more properly 'blowing,' of the Whale is nothing more than the ordinary act of expiration, which taking place at longer intervals than in land animals, is performed with a greater amount of emphasis. The moment the animal rises to the surface it forcibly expels from its lungs the air taken in at the last inspiration, which, of course, is highly charged with watery vapor in consequence of the natural respiratory changes. This, rapidly condensing in the cold atmosphere in which the phenomenon is generally observed, forms a column of steam or spray, which has been erroneously taken for water. It also often happens, especially when the surface of the ocean is agitated into waves, that the animal commences its expiratory puff before the orifice has quite cleared the top of the water, some of which may thus be driven upward with the blast, tending to complete the illusion. In hunting Whales the harpoon often pierces the lungs or air passages of the unfortunate victim, and then fountains of blood may be forced high in the air through the blowholes, as commonly depicted in scenes of arctic adventure; but this is nothing more (allowance being made for the Whale's peculiar mode of breathing) than what always follows severe wounds of the respiratory organs of other animals."

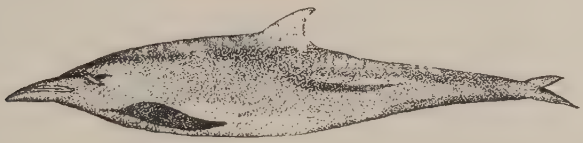

FIG. 93. COMMON DOLPHIN (*Delphinus delphis*). (After Flower.)
Length of adult, 10 feet.

The refined oil known as "spermaceti" is manufactured from that oil which is found in the great cavity above the skull in the Sperm Whale, while "ambergris," so extensively used by perfumers in their art, is found in the intestines of the same animal, and sometimes floating on the surface of the seas they inhabit.

By the aid of modern appliances, the chase and capture of these huge mammals has within recent times been reduced almost to a science, but an account of such matters would, in the opinion of the writer, be out of place in the present connection, dealing as we are more particularly with the life histories of these Cetaceans; it will be as well to add, however, that their constant pursuit and destruction by man must in due time tell markedly on their numbers, if it does not lead to their actual extermination.

Glancing again at our List above we find that these Cetaceans are primarily divided into Families of TOOTHED WHALES, BOTTLE-NOSE WHALES, SPERM WHALES, and WHALEBONE WHALES. Among the first of these we find the Common Dolphin (see Fig. 93) *(D. delphis)*, and who that has ever been out for an ocean voyage over the seas that he inhabits, does not know him. Suddenly a "school" of them will appear under the very bows of your vessel, plunging in and out of the water in graceful curves, and in a manner most fascinating to the observer, who never wearies of the sight. Their powerful, tooth-armed beaks are the very terror of the small fishes upon which they habitually prey, and it is an extraordinary thing to see the agility with which they effect such captures.

Captain Scammon, speaking of the Common Porpoise of the Pacific coast, says, "They are seen in numbers varying from a dozen up to many hundreds tumbling over the surface of the sea, or making arching leaps, plunging again on the same curve, or darting high and falling diagonally sidewise upon the water with a spiteful splash, accompanied by a report which may be heard at some distance. In calm weather they are seen in numerous shoals, leaping, plunging, lobtailing and finning, while the assemblage moves swiftly in various directions. They abound more along the coasts where small fish are found. Occasionally a large number of them will get into a school of fish, frighten them so much that they lose nearly all control of their movements, while the Porpoises fill themselves to repletion." This species is the *L. obliquidens* of our List. On our New England coast the best known form is the "Skunk porpoise," shown in Fig. 94 of the present chapter, and its habits are fully as interesting as those of the Dolphin of which we have just been speaking. Even at the present time, it is by no means a rare thing to discover a new species of this group, and undoubtedly there still remain a number of forms as yet unknown to science.

The Orcas or Killer whales constitute another genus of this family, and they are only too well known to the whalemen as the veriest wolves of the high seas, often robbing them of their hard-earned spoils. They are possessed of enormous strength and speed, and even at a distance at sea they can be easily recognized by their lofty dorsal fins, an appendage which, in the High-finned killer, attains to the enormous height of six feet. These merciless animals will ravenously attack and kill the biggest whale

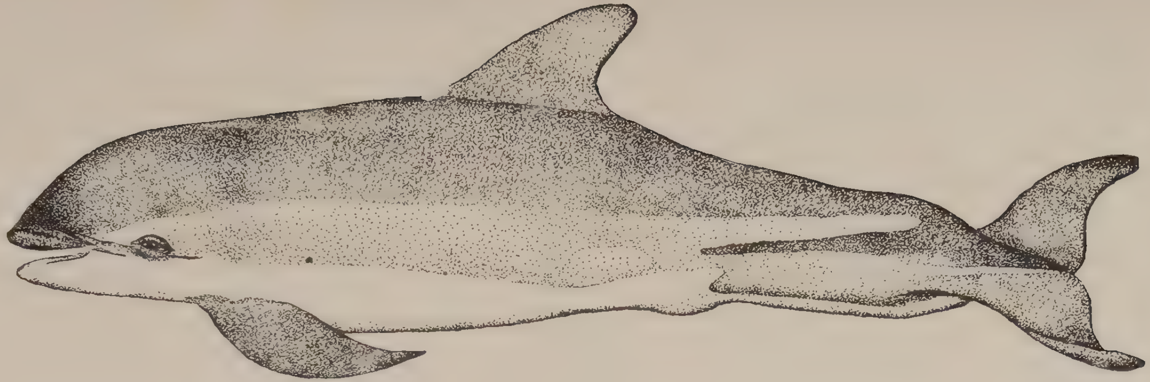

Fig. 94. Skunk Porpoise (*Lagenorhynchus gubernator*).
Drawn by the Author. (From Goode after Cope.) Length of adult, about 10 feet

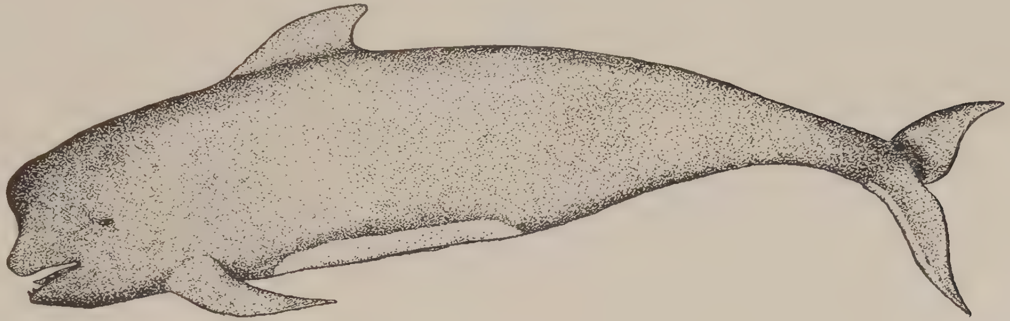

Fig. 95. The Blackfish (*Globiocephalus melas*).
By the Author after Goode. (See Trans. Zoöl. Soc. Lond. Vol. 8, Pl. 30.) Length of adult, 18 to 25 feet.

that ever plowed the ocean, and devour the carcass afterward, piecemeal; they are also very destructive of the seals about the islands inhabited by those valuable animals, and according to Professor Goode, Eschricht says that thirteen porpoises and fourteen seals were found in the stomach of an Atlantic Killer, sixteen feet in length.

The Blackfishes (Fig. 95) are a medium-sized whale that range over their oceanic habitat in schools sometimes numbering several hundreds; they are not especially valuable to the whalers, but are mercilessly preyed upon by the Killer whales.

Rarer than the last-mentioned species, though often associated with them, are the Grampuses (Fig. 96), a smaller whale than they though with very similar habits, and we are told that they make their appearance in our waters only about once in ten years. Professor Flower has proved beyond all manner of doubt that the fantastic markings on the body of this animal are normal and are not due to scars from conflicts with their fellows or other species. A fine cast of a Grampus may be seen and studied at the Smithsonian Institution, where it used to surmount the doorway of the main entrance, down-stairs.

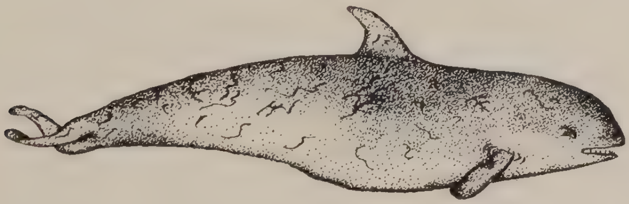

FIG. 96. THE GRAMPUS (*Grampus griseus*).
By the Author, after Elliott. Length of adult, 20 feet.

One of the most interesting of all Cetaceans is the Narwhal (Fig. 100), an animal which stands responsible for the Unicorn of fancy, and which is now restricted in its range to the northern shores of our Alaskan territories. The spiral tusk growing from the left side of its upper jaw is a modified tooth which may attain a length of eight or ten feet. It is absent in the female, the sex being practically toothless, or at least the teeth are concealed in the jaw as is the case on the right side in the male Narwhal. This tusk is without enamel, and a single one is valued at $50, the ivory being put to a variety of purposes. Occasionally both tusks are developed, in which case the spirals each turn the same way, or the twist has the same direction. Norwhals feed upon small fish and crustaceans.

Herring Hogs *(Phocœna)* are representatives of another very interesting genus (Fig. 97); these animals are also known as the Harbor porpoises or " puffing pigs "; they have earned their last name from their habit of puffing and grunting as they disport themselves in the surf or as they roll in the breakers at the mouths of harbors and rivers. These Herring hogs are very destructive of several species of the small edible fish, and of oysters, but they in turn are often attacked and killed by the Porpoises.

To represent the next family, the Bottle-nose whales, I have given a figure of *Hyperoodon bidens*. But very little is known of these forms and the nomenclature of the group is not in a very satisfactory condition.

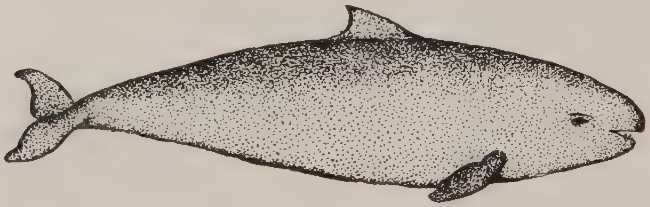

FIG. 94. THE " HERRING HOG" (*Phocœna communis*).

Copied by the Author from a photograph by the U. S. Fish Commission. Length of adult, rather more than 4 feet.

Passing next to the family of the true Sperm whales *(Physeteridœ)*, we find them represented by the Giant Sperm and the Pigmy Sperm whales.

The Sperm whale or Cachalot *(P. macrocephalus)* is a very well-known cetacean, one of wide distribution and of great commercial importance (Fig. 98). In this species the male may attain the enormous length of 84 feet, whereas the females are not more than one-third as large, and are slenderer. In color these animals are of a blackish brown above, paler on their sides, and grayish on the under parts; very old ones are gray on top of the head and about the nostrils. They feed on small fish principally, and squids; it is related that several hundred mackeral have been taken from the stomach of a third grown one. All times of the year is the breeding season for them, and one at a birth is the rule, never more than two. The female nurses her young by re-

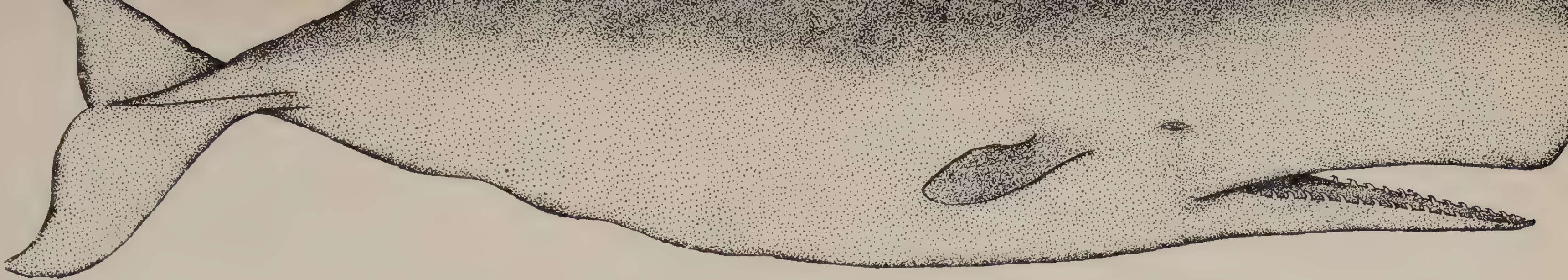

Fig. 98. The Sperm Whale (*Physeter macrocephalus*).

By the Author, from Goode, after Scammon. Length of adult male, 84 feet.

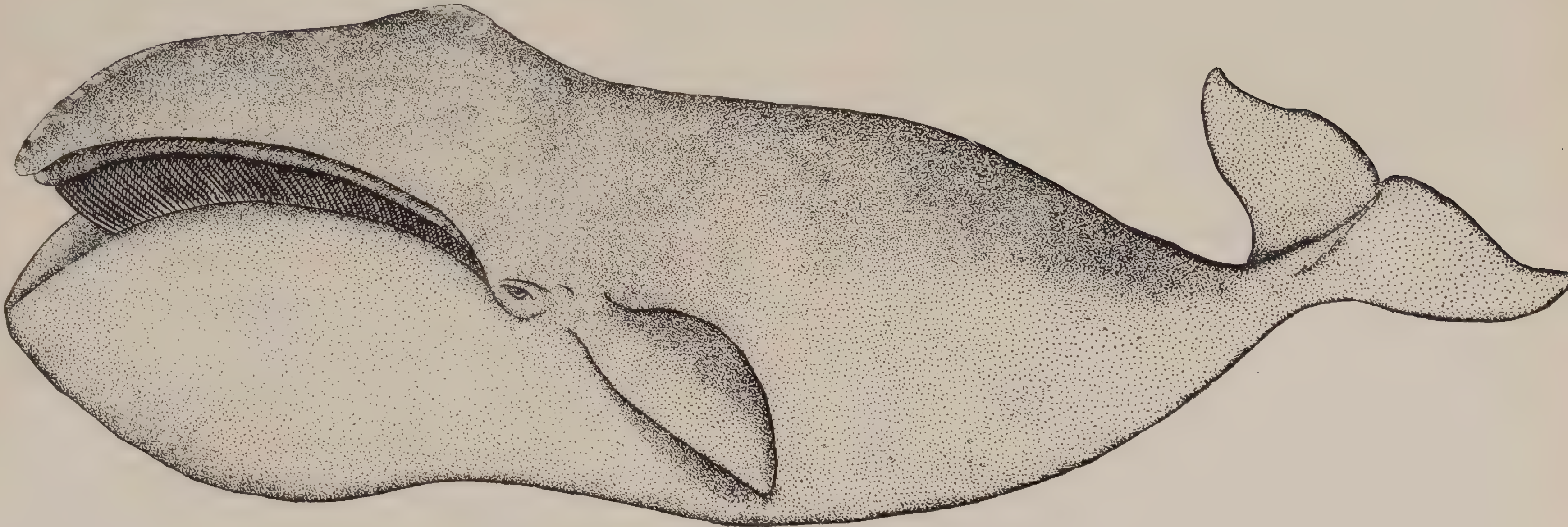

Fig. 99. The Bowhead Whale (*Balæna mysticetus*).

By the Author, from Goode, after Scammon. Length of adult male, 47 feet.

clining quietly on her side, as she floats passively on the surface of the ocean. The period of gestation is said to be ten months.

Its actions and habits under various circumstances are familiar to the most of us, and have been well described by Scammon; the "blowing" of this whale, and the usual products it yields, I have already alluded to above.

Turning to the Suborder MYSTICETE of our List, we find a splendid array of species representing the animals known as the Whalebone whales, all of which are creatures of great size, and valuable for the products they yield to men. Of no little importance among these is the whalebone of commerce, but this is principally obtained from the Bowhead whale (Fig. 99) of the Polar Seas. The habits of the Bowhead partake of the habits of whales generally, with a number of very interesting ones peculiarly its own. Professor Goode remarks that "The food of the Bowhead consists of floating animals, classed by the whalemen under the names 'right whale feed' and 'brit.' Many kinds of invertebrates are, of course, included under these general terms, one of the most abundant of which is, perhaps, a kind of winged or pteropod mollusk, the *Clio borealis*, which occurs in the northern seas, floating in great masses. When the Bowhead is feeding it moves with considerable velocity near the surface, its jaws being open to allow the passage of currents of water into the cavity of the mouth and through the layers of baleen at the sides. All eatable substances are strained out by the fringes of the baleen and are swallowed." Much more could be said about these whalebone whales, but I find my space already nearly exhausted, and I still have a few concluding remarks to make of no little importance.

My studies of the Cetaceans and my reading about them have both convinced me that the Order has by no means received the attention at the hands of descriptive zoölogists and anatomists that it so justly deserves. This neglect can be atoned for in many ways, and more especially by such persons as reside the year round either upon the Atlantic or Pacific seaboards, or by capable observers who lead a seafaring life. Lighthouse keepers and whalemen both have excellent opportunities to thus powerfully aid science in such work. Whalemen should be encouraged by some means to systematically capture specimens of the smaller Cetaceans when the opportunity is afforded them, and from these to take accurate measurements of the specimens at the time of capture. Skeletons could also be made, and viscera placed in crude spirits, both being brought home and turned over to the proper authorities for description. And, when it so happens that somebody chances to be on board who can make a serviceable sketch of the animal, this essential aid should never be overlooked; the habits of whales in their normal habitat should also be constantly recorded, and particularly as soon after the observation as possible. Lighthouse keepers and other seashore observers can effect all this, and much more besides, for where any of the whale tribe are driven ashore in their vicinity, they can, in addition to what is suggested above, often be enabled to take a good series of photographs of the specimen, as well as a very complete set of measurements. When within a reasonable distance of Washington, they can, too, immediately send a telegram to Mr. F. W. True, Executive Curator of the U. S. National Museum, that such and such suspicious looking specimens have gone ashore at such and such a point, thus giving the proper authorities the opportunity to dispatch a responsible person to the spot should they desire to do so. There are undoubtedly a number of the smaller species of Cetaceans in our waters as yet undescribed.*

From the consideration of the Whales we may pass to an entirely distinct order of large aquatic mammals, that by nature are partly amphibious. I refer to the Manatees of the Order *Sirenia* (Sea Cows), including the family *Trichechidæ*, which contains two forms or species, namely the South American Manatee *(Trichechus manatus*, Linné) and the Florida Manatee *(T. latirostris*, Harlan), True.

My personal knowledge of the Manatees is principally based upon having carefully studied the skeletons and other material afforded by the Museums, and having seen a live one once on the west coast of Florida, and another, some twenty-seven or eight years ago, about half a mile up the Coatzacoalcos River on the

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*Those of my readers desiring to further inform themselves upon the subject which of necessity I have been compelled to deal with so briefly in this chapter, can do no better than consult some of the following works:

Bibliography of Cetacea: D. F. Eschricht, "Untersuchungen über die Nordischen Wallthiere," 1849. "Ostéographie des Cétacés," by P. J Van Beneden and P. Gervais, 1868–79. C. M. Scammon, "Marine Mammals of the N W. Coast of North America," 1874. For the structure of whalebone, see Hunter, "Observations on the Structure and Economy of Whales," Phil. Trans., 1787; Eschricht and Reinhardt. "On the Greedland Right Whale," English translation by the Ray Society, 1866, pp. 67-78; and Sir W. Turner, in Trans. Roy. Soc. Edin., 1870, Thomas Beale; "Natural History of the Sperm Whale," London, 1836, Andrew Murray; "The Geographical Distribution of Mammals," London, 1866, p. 212. T. N. Gill; "Sperm-Whales, Giant and Pigmy," Amer Nat. iv, p 738, fig. 167. Capt. David Gray; *Land and Water*, Dec. 1, '77, p. 468, and many other special monographs.

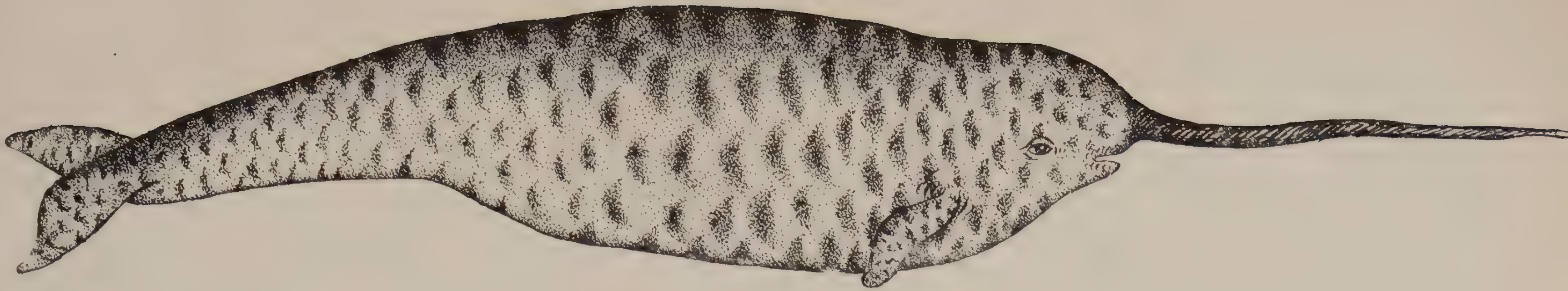


FIG. 100. THE NARWHAL (*Monodon monoceros*).

By the Author, after Elliott. Length of adult, 10 to 14 feet.

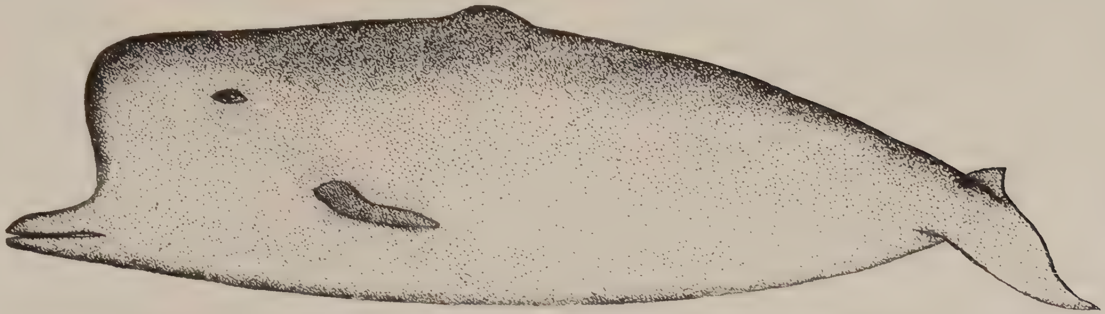


FIG. 101. THE SPERM WHALE PORPOISE (*Hyperoödon bidens*).

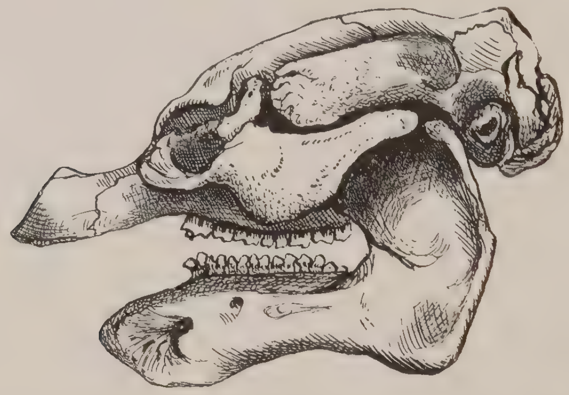
By the Author, after Blake. Length of adult, 25 feet.

Isthmus of Tehuantepec, southern Mexico. This last one I saw from the deck of a steamer, and I remember very well that it was in shallow water, and that it had drawn itself partly out on the muddy ooze of the bank, so that its form was very fairly exposed to my view.

Nevertheless I am quite familiar with this Order of Mammals, and it will be my aim here to review some of the more important parts of the history of them so far as it is at present known to naturalists.

Geology goes to show that the early Pliocene and Miocene seas of Europe swarmed with several species of animals, which zoölogists have good reason to believe were the latter extinct ancestors of existing Sirenians *(Halitherium)*. But the intermediate forms which connected our living types, such as the Manatee, with the ancient ones, to which I refer, have not as yet been discovered. Zoölogists have also held, and I think it is very probable too, that the Manatees and their kind are in some way related links, remotely affined to the Cetaceans on the one hand, and the Ungulata on the other; but even of this kinship the evidence is as yet not satisfactorily demonstrated. Various other extinct sirenian species have received different names at the hands of paleontologists, but it is not our object to further pursue this part of the subject here; one form, however, recently exterminated, fully deserves a word of passing notice, and I have reference of course to the Northern Sea-cow *(Rhytina stelleri)*.

Of it, Professor Flower has said, "Only one species of this genus is known, *R. stelleri*, the Northern Sea-cow, by far the largest animal of the order, attaining the length of 20 to 25 ft. It was formerly an inhabitant of the shores of two small islands in the North Pacific, Behring's and the adjacent Copper Island, on the former of which it was discovered by the ill-fated navigator whose name the island bears, when, with his accomplished companion, the German naturalist, Steller, he was wrecked upon it in 1741. Twenty-seven years afterward (1768), as is commonly supposed, the last of the race was killed, and its very existence would have been unknown to science but for the interesting account of its anatomy and habits left by Steller, and the few more or less perfect skeletons which have recently rewarded the researches carried on in the frozen soil of the islands around which it dwelt. There is no evidence at present of its having inhabited any other coasts than those of the islands just named, though it can hardly be supposed that its range was always so restricted. When first discovered it was extremely numerous in the shallow bays round Behring's Island, finding abundant nutriment in the large laminariæ growing in the sea. Its extirpation is entirely due to the Russian hunters and traders who followed upon the track of the explorers, and who, upon Steller's suggestion, lived upon the flesh of the great Sea-cows. Its restricted distribution, large size, inactive habits, fearlessness of man, and even its affectionate disposition toward its own kind when



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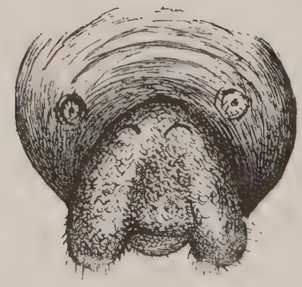

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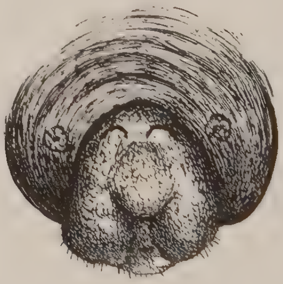

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FIG. 102. SKULL OF AFRICAN MANATEE (*Manatus senegalensis*).

× 1-5. (After Flower).

FIG. 103. THE FRONT VIEW OF THE HEAD OF THE AMERICAN MANATEE.

Showing the eyes, nostrils and mouth, and with the lobes of the upper lip divaricated.

FIG. 104. THE SAME.

With the lip contracted. (After Flower, from Murie.) These figures all copied by the Author.

wounded or in distress, all contributed to accelerate its final extinction."

Professor Nordenskjöld has claimed and in the writer's opinion upon too insufficient evidence, that living specimens of this sirenian were known to exist in the locality above referred to as late as the year 1854. This matter has been more carefully examined into by Dr. Stejneger, who it would seem has very successfully refuted this erroneous notion.

We now pass to the existing types of these interesting animals, and find that there are but two genera of them, viz.: *Halicore* and *Manatus* (or *Trichechus* of other authors, and as given above), the first contains the famous Dugongs, sirenians very distinct in their structure from our Manatees, but as they are denizens of "the shallow bays and creeks of the Red Sea, east coast of Africa, Ceylon, islands of the bay of Bengal and the Indo-Malayan Archipelago, ranging from Barrow Reefs on the west to Moreton Bay on the east," they cannot roperly claim our time and space here, as interesting as they are in many particulars. Even our own Manatee has a closely related African cousin *(M. senegalensis)*, and of which form I have given a view of the skull in the present chapter (Fig. 102), as I had not one of the American ones at my hand.

There are two species of American Manatees, but only one of these belong to our United States fauna, the Florida manatee, a form that, so far as this country is concerned, is now confined to the coasts of the peninsula from which it takes its name. Owing to the fact that most of the specimens of Manatees that have reached Europe are the South American animals, and further, as it was very natural that they should figure that form in the "Transactions," this will account for my presenting here a group of those animals in lieu of our own species; however, when reduced to this small size they are hardly distinguishable in the drawing which illustrates the present chapter.

Manatees are enabled to use the paddles formed by their forearms with considerable facility, and this is undoubtedly the way in which they originally came by their name, it being derived from the Latin word for hand. *Manatus*, moreover, is the technical name applied by some zoölogists to the genus that has been created to contain them. According to True, Mr. W. A. Conklin, director of the Central Park menagerie, in New York city, gives the following dimensions of a specimen kept alive in that establishment in 1873, these being the only reliable measurements of a Florida Manatee, under its proper name, on record: "Length, 6 ft. 9½ in.; circumference around the body, 4 ft. 9 in.; length of flipper, 1 ft.; width of same, 4¾ in.; width of tail joining body, 1 ft. 6¾ in.; greatest width of tail, 1 ft. 8½ in.; weight, 450 lbs. It is very likely, however, that the animal may attain to a length of at least 8 or 9 ft., as trustworthy authorities so state, in which case they would come to weigh something between five and six hundred pounds.

The figures here given so thoroughly portray the general form of the Manatee, that it hardly seems necessary to enter upon any very extended description in this place; we are to especially note, however, the fish-like form of the body, terminating behind in the broad, somewhat rounded and horizontal tail; the constricted neck connecting this body with a rather small, oblong head; the complete absence of hind limbs, with the fingerless paddlelike forelimbs, the latter tipped on either side with three small nails; the total absence of all fins; the wonderful minute eyes and ears, the latter being without any external pinna; the great tumid upper lips overarching rather a large mouth, the former having a sparse growth of stiff bristles growing upon them; the wrinkled skin, which is of rather a deep gray color, and having a few scattered hairs growing over it in some specimens, more especially in the younger individuals. But of all the external characters of a Manatee none are so noteworthy as the fleshy pads, one on either side, that go to form the extraordinary upper lip. Professor Garrod in alluding to these, says of them that, "These pads have the power of transversely approaching toward and receding from one another simultaneously (see Figs. 103 and 104). When the animal is on the point of seizing, say, a leaf of lettuce, the pads are diverged transversely in such a way as to make a median gap of considerable breadth. Directly the leaf is within the grasp the lip-pads are approximated, the leaf is firmly seized between their contiguous bristly surfaces, and then drawn inward by a backward movement of the lower margin of the lip as a whole."

It is said that Manatees have the power of carrying their young about within the grasp of their forelimb or limbs, and that their appearance at these times has given rise to the fabulous mermaid of nursery tale renown, but so far as the writer is concerned, if these mythical maids of the sea, which so often filled my dream-head in boyish days, or my fanciful reveries of perhaps riper

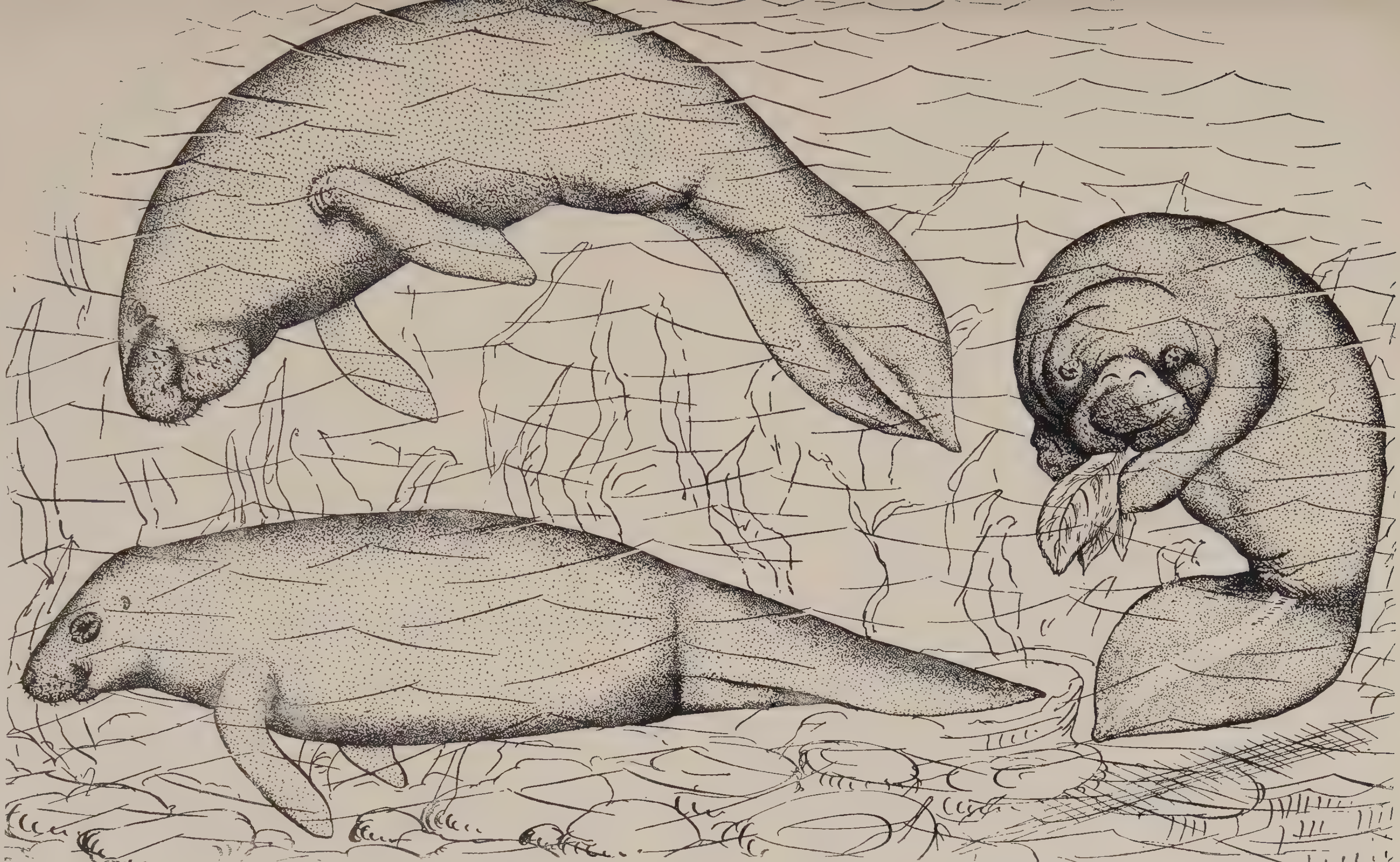

FIG. 105. SOUTH AMERICAN MANATEES.

Attitudes of Swimming.

FIG. 106. MANATEE IN ACT OF FEEDING.

years, bore any resemblance to the beauty that sits up on the tip of her tail in the group herewith presented, I beg to be excused an introduction. Certain it is, however, that these animals can make considerable use of these paddles of theirs, for with them they assist in tucking their food into their mouths, and in moving about on the bottom of the river or lagoon where they may be feeding, they use them in conjunction with the tail, in assisting their locomotory acts.

Manatees avoid getting into the open sea, but habitually resort to the shallower waters of rivers, bays, and lagoons, where they move sluggishly about on the bottom, browsing much in the same way that the terrestrial herbivora do upon land, their food consisting exclusively of the aquatic plants which so abundantly grow in such situations. In quiet weather, they sometimes seem to enjoy getting into deep water, where by the assistance of their lungs, they are permitted to float at the surface, which they do arching their body in a peculiar manner. Indeed, their lungs seem to act very much in the same manner as the swim-bladder of fishes is known to operate, and while Manatees are feeding they may be seen to rise every few minutes to the surface to breathe, but instances of their getting completely out on the land remain yet to be proved, and when placed there, their acts are in the extreme most awkward. So far as their senses are concerned these creatures have fair eyesight, acute powers of hearing, and the other powers probably well developed. They are not known to be possessed of the ability of emitting any voice-sound. They seem to bear captivity well, and living specimens have been studied with great interest and advantage at the Zoölogical Gardens of London, where they have been successfully kept. In behavior, they always seem to be gentle and inoffensive, exhibiting on all occasions great concern and affection for their young. Indeed, man has proved to be their greatest enemy, and they are forever pursued and captured for their flesh and skin and the oil which they yield. Thus it is that Manatees are on the road to extinction, which, everything considered, in time is sure to come about. The methods of capturing the Manatee are many: (1) they may be shot as they rise to the surface to breathe, an operation that requires great skill and quickness; (2) they are taken in some localities by means of an ingenious kind of net; (3) finally, they are captured by the various modes of spearing and the use of the harpoon.

So far as the breeding habits of the Manatee are concerned, but little or nothing is known; the best authorities have it that the period of gestation lasts eleven months, and the young follow their mother about for six months or perhaps longer. It is a well known fact, of course, that the dam suckles her young at her breasts, there being two mammæ, which are post-axillary in position.

In concluding, it gives me pleasure to state that in my account of this animal, I have been much assisted through my perusal of True's history of it in that admirable work, published by the United States Commission of Fish and Fisheries, entitled "The Fisheries and Fishery Industries of the United States." Mr. True in closing his article in that work, says, "In the Manatee, then, we have an animal of great size, of gentle disposition and apparently of rapid growth, which lives in places readily accessible to man, and is easily captured, and which furnishes meat which is not inferior, oil which is remarkably fine, and leather which possesses great toughness. From these considerations it would seem evident that, with the proper protection, it would furnish no small revenue to the people in those portions of our country which it inhabits, for centuries to come" (p. 128).

Finally, to those interested in the progress of science in Florida, I should say that we have not as yet by any means a complete history of this animal, and accurate reports upon the following subjects are very much to be desired: (1) an accurate observation giving all the circumstances of a Manatee voluntarily coming ashore to feed or for any other purpose; (2) the manner of coition, the period of gestation, the mode of delivery, the number of calves at a birth, how the latter are suckled, their size and appearance, and how long they remain with their dam, and (3) a great deal of their structure and anatomy, are all subjects almost unknown to us.

CHAPTER XXVI.

THE FLYING SQUIRREL AND ITS RELATIVES.

(Family *Sciuridæ.)*

SQUIRRELS, the world over, constitute a very large group of mammals that naturalists associate together in the family *Sciuridæ*, it being one of the principal families of the order Rodentia. In North America the *Sciuridæ* are chiefly represented by the marmots, the chipmunks, the spermophiles, the squirrels, and the flying squirrels. In this country we have at least two well-marked forms of the last-named species; namely, the Northern flying squirrel *(S. v. hudsonius)*, and the Southern flying squirrel *(S. v. volucella)*, the former inhabiting the upper part of California and northward through the Pacific regions to the Rockies, while the latter variety occurs in all suitable localities over the United States, except where *hudsonius* is found. It also ranges through Mexico and Guatemala.

Occasionally, in the old works upon the natural history of these animals, we find the American flying squirrels called *Assapans*, the origin of which term has just now escaped me. There are also animals in eastern Asia that have been called *Taguans*, but they are flying marmots of the genus *Pteromys*, allied to the squirrels. Both possess lateral dermal expansions, by means of which they can for certain distances sail through the air, upon launching themselves into it from some elevated position.

Anatomically, our little flying squirrels very closely resemble the typical members of the genus *Sciurus;* their large, full eyes, certain dental differences, and the possession of the dermal parachute being evident distinctive differences. Flying squirrels are also of small size. *Sciurus volans*, of Linnæus, is the flying squirrel of Europe, popularly called the *Minene* in some quarters, and the King of the Squirrels (König der Grauwerke) by the Germans. In many of its habits it is said to agree with our *Sciuropterus*, but is more solitary in disposition.

Around my present home the little flying squirrels are quite plentiful, and they have taken to living under the eaves and in the water pipes of the house, and not long ago a very beautiful little specimen came into the kitchen one morning, where he was captured by the cook, and is now kept by me in a small cage I constructed for his occupancy. About a week after I had him I succeeded in getting some good photographic pictures of his squirrelship, and one of the best of these has been reproduced to illustrate this chapter.

They make extremely engaging pets, being gentle, soft, and fluffy, with many curious little habits, and withal, stand among mammals as the prettiest forms we know anything of. His silky coat is brownish-ash above, pure white beneath, with a black emargination above the lateral edge of the dermal expansion upon either side. No tuffs ornament the ears, as in some squirrels, and his head is short and rounded, with the face lacking in that acuteness seen in some members of the tribe. As I have said above, his eyes are very prominent and black, while the tail is soft, flat, and distichous. They vary considerably in coloration, some being much darker than others; some are very light indeed.

Where the conditions are favorable for them, these squirrels become very numerous; but being chiefly nocturnal in their habits, are rarely seen in the daytime by any one. Hollows of trees are the favorite places for them to nestle in and slumber away the hours of daylight, but other convenient excavations or crevices will be often utilized by them. They are very fond of Indian corn; nuts, apples, and other fruits; seeds, and, agreeing with most other rodents, will eat raw meat with avidity whenever they get a chance.

They produce from three to a half dozen young to the litter, usually breeding once in the north during the season, but frequently as many as three times in the extreme south. Gestation is of about a month's duration. Extreme solicitation is experienced for the young by the parents, and the old one will often carry a squirrelet back into the nest should it from any cause have tumbled out. At evening time, and during most of the night, these little animals are wonderfully active and frolicsome.

Many years ago I remember having once passed through a stretch of forest on a moonlight night that I had frequently traversed during the daytime, and that without ever having suspected a flying squirrel's presence in the place; but now dozens of them were to be seen, and I paused for a long time to study their antics. They would run up to the tops of the trees, then out upon the extremities of the branches, from whence they would leap and sail out into the open space. In the air the tail is held

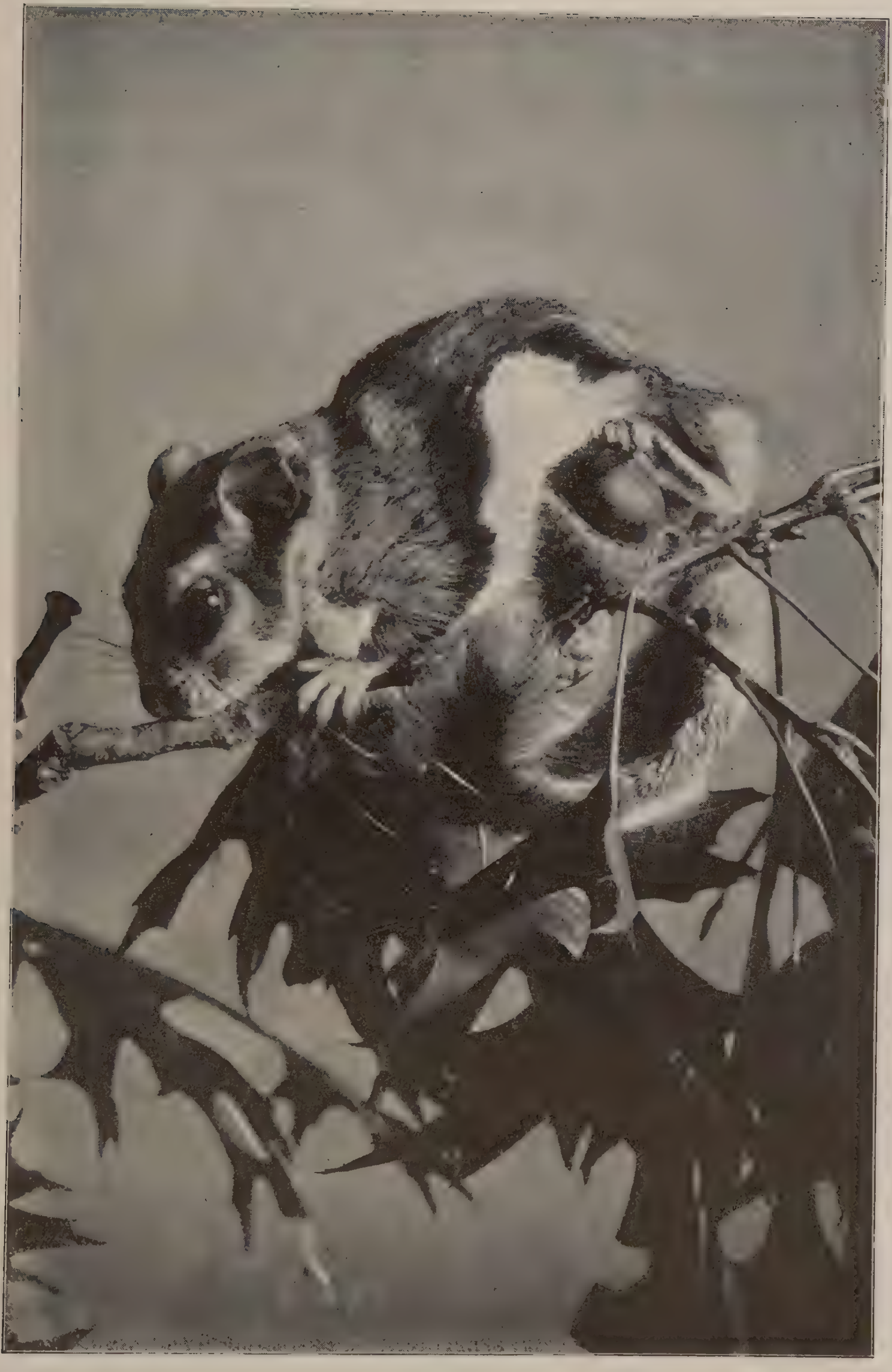

FIG 107. THE FLYING SQUIRREL (*Sciuropterus v. volucella*)

From a photograph from life by the Author. Nearly natural size.

in the same plane with the body, while the latter is flattened out, the legs are extended, and the lateral dermal sheets put upon the stretch. Forty or fifty yards are sometimes thus passed at one flying leap, the trajectory being a gentle curve—for its first two-thirds downward, to terminate upon an upward inclination as the animal makes a graceful landing upon the place for which it had started. This is usually upon the trunk of another tree, or, if convenient, one of the main branches. As they pass through the air the flight is even, fairly swift, and very remarkable, the animals appearing—as they pass overhead or descend near you—like little square pieces of white pasteboard sailing through the air, much after the fashion that certain tricksters flip playing cards for extraordinary distances, the curves described being quite similar.

Flying squirrels evidently appear to enjoy these aerial exploits, for they will pass to and fro between the same two trees a number of times in succession, running up to the top of one, to leap and sail over to the other, which in turn is ascended only to fly back to the one they had just quit. When traveling in numbers through the forests, however, these flights get them over the territory traversed in very short order, a mile or more being made in hardly any time at all.

Flying squirrels have but little to dread from man; but that they are preyed upon by owls, weasels, and a few other animals there is no room for doubt; and probably they are also frequently destroyed through other agencies, or else they would so vastly increase that their number would soon be immense, and their existence in many localities be made far more evident.

A curious instance is recorded by a popular writer at hand, "in which a brood of young squirrels of this species were kept in confinement for some months. The mother suckled her young ones by clinging with her forefeet to the perch of the cage, letting her body hang down, while the little ones stood on their hind legs and took their meal from her breast. This brood was procured by some laborers, who, in clearing a wood by setting it on fire, saw the mother carry them one by one from the burning tree to a place of safety. When they took her, she was found to be singed. This good and devoted mother had three of her young ones killed by the rats, which got into the cage at night, and she herself had one of her thighs broken and a part of her flesh eaten from her body to the bone, yet she was found in the morning clinging to her little ones and trying to nurse them!"

In the fore part of either " wing," in any specimen of our flying squirrels, the student will find a slender, subosseous splint extending from the wrist into the interdermal space of the lateral extension, or " wing," as I have just termed it. Arboreal rodents of the family *Anomaluridæ,* several species of which are found in West Africa, possess an homologous splint, but it articulates at the elbow (the olecranon) instead of at the carpus, or wrist, as in *Sciuropterus.* These African forms *(A fulgens*, for example) have also peculiar scales upon the under side of the fore part of the tail that assist them in climbing and alighting upon a rough surface after flight.

Some of the large East Indian species of flying squirrels are very elegant creatures, the fur of which is often high colored. *Pteromys nitidus,* for instance, is larger than our gray squirrel, and is of a deep chestnut above, while its nether surface is of a bright red. Others show various shades of orange, bay, or black. These likewise possess the splint bone in their dermal parachutes, serving as " stretchers " or " auxiliary extensors," when the latter are spread in the act of sailing in the air. We have much yet to learn of the habits of these Bornean, Javanese, and other foreign species, and as for the details of their anatomy we are even still less informed upon.

In the Australian region there is another group of animals that possess flying membranes as in our flying squirrels; they are representatives of the three genera, *Petaurus*, *Belideus*, and *Acrobata*, of the family of *Phalangistidæ,* or Phalangers, as they are called. These are marsupial forms ranging in size all the way from that of a mouse to species as big as a cat. The habits and mode of life of these peculiar animals are extremely interesting, and well deserving of the study of the natural historian.

Among the insectivora we also find a flying mammal; namely, the two species called the "flying lemurs," a name given to the first known one by Linnæus. They constitute the family *Galeopithecidæ;* the *Galeopithecus volans* being the type most frequently seen in collections. *G. philpinensis* is the other species, and they both occur in the forests of the Malay peninsula, Sumatra, Borneo, and the Philippine Islands. By the natives this animal is called the *Kabung;* others term it the Colugo; while many old works on natural history have them flying lemurs, flying foxes, or flying cats.

The integumentary parachute in them is even far more extensive than it is in our little flying squirrels, for it is not only a lateral extension, but interdigital and interfemoral (as in bats) besides. They are nocturnal, too, and feed upon insects and the leaves of certain trees. It is capable of taking immense flights, has but a single young one at a time, possesses pectoral mammæ, as in bats, and has some very remarkable habits. So, from what I have endeavored to present above, it will be seen that our modest little flying squirrels—apart from the bats—are not the only mammals that are capable of flight of a certain kind, for they are indeed the least conspicuous, perhaps, among the forms thus endowed.

Passing once more to a brief consideration of the Rodentia as a whole, it is to be observed that the best authorities among modern classifiers of mammals, divide the order into two suborders, viz., the *Simplicidentata*, and the *Duplicidentata*. Both of these suborders are represented in the fauna of the United States; the first containing ten families, and the latter but two; —the *Sciuridæ* being the first family of the Simplicidentata. This family contains, in addition to the genus of flying squirrels *(Sciuropterus)*, just considered, the woodchucks or marmots *(Arctomys)*; the chipmunks *(Tamias)*; the spermophiles *(Spermophilus)*; and the typical arboreal squirrels *(Sciurus)*.

Of the Chipmunks or Ground Squirrels there are quite a number of species and subspecies in the United States, and these are constantly being added to by new discoveries. As a group, they are well-represented by our common eastern Chipmunk, familiar to every one who knows anything of our smaller mammals of the Atlantic States. Some of the other forms resemble it quite closely, while others depart more or less from it in the matters of size and coloration; some are distributed over a considerable geographical area, others being more or less restricted to their ranges, thus offering descriptive zoölogists abundant opportunity to describe the fine intergrading forms as new subspecies, an opportunity that has been fully availed of, by a few ambitious mammalogists more anxious to add to a personal reputation, than to be of any special use or aid to the science which they pretend to advance.

While collecting in New Mexico during the 80's I obtained numerous specimens of the Gila chipmunk, a subspecies wherein the lateral longitudinal dorsal stripes are almost entirely absent (Fig. 108), though a medium one is quite distinct.

These various species of Ground squirrels are known by different names in different parts of the country. In many localities the people call them Chipmunks, or Chipmucks; elsewhere they bear the name of Hackee; while in the eastern part of the United States Chipping squirrel or Striped squirrel is occasionally applied to them. They very rarely ascend trees but spend most of their time on the ground, or scampering along fence-rails, over stumps and rocks, and live in holes in the ground, usually among the gnarled and exposed roots of some big tree or other. They are extremely frolicsome, and often exhibit but little fear of man's approach, though as domesticated pets they are but rarely interesting. In nature the Chipmunks have many enemies, thousands of them being annually destroyed by the smaller canivora, as well as by hawks and owls. In fact its life is one of continuous peril from these causes. Many are shot by juvenile sportsmen, be it said to their shame, for the harmless little fellows add more than their share to the enlivenment of our forests and glens by their merry chippings and well-known gurgling scoldings common to so many of the smaller squirrels. Says a popular writer: "In the autumn this creature may be seen around the fields of Indian corn, and in the walnut and chestnut woods, filling his ample cheek-pouches, and carrying off his store to his granaries. His hole is generally placed near the roots of trees, or in a decayed stump, or among a heap of rocks, or in a bank of earth, and usually near the forests or fields from which he draws his supplies. Sometimes his retreat has two or three openings; it usually descends almost perpendicularly at first; then it rises with one or two windings, and at last, at the distance of eight or ten feet, terminates in a chamber lined with leaves, amid which the animals sleep. Three or four occupy the place together. There are several side-galleries, where the stores of wheat, buckwheat, hazel-nuts, acorns, Indian corn, grass-seeds, walnuts or chestnuts, according to the productions of the locality, are deposited. They are exceedingly provident, continuing to add to their supplies till forced into their houses by the inclemency of the weather. Often their stores are much beyond the necessities of the winter. The squirrels hibernate in these retreats, and become somewhat sluggish, but do not approach the unconcious torpidity of the marmot. The young, four or five at a birth, are produced in the spring, and beautiful little creatures they are when first led forth by the mother."

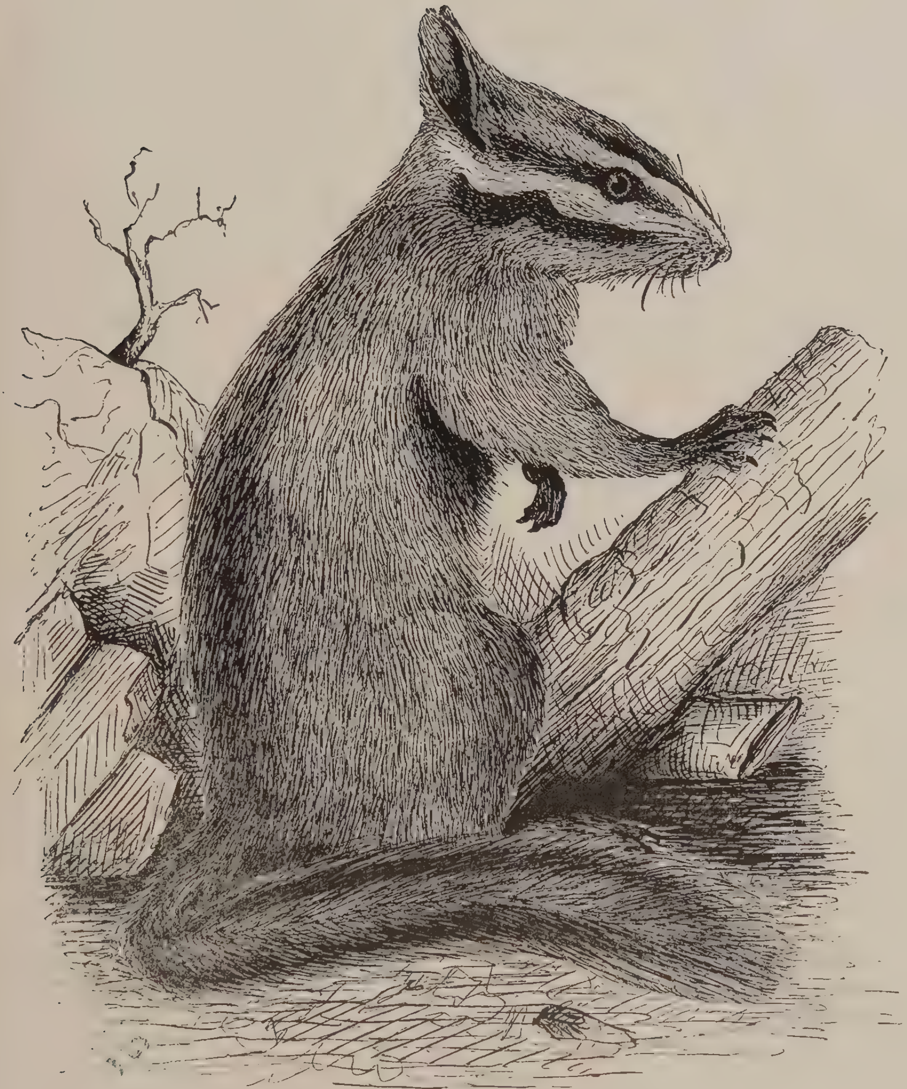

FIG. 108. THE GILA CHIPMUNK.

Adult Male, Life Size.

In our southern districts, where the winters of course are very mild, these little animals remain out the entire year round, but are never harmful to the crops of man, being simply gleaners rather than robbers and destroyers. Other forms of the genus differ but little in habit from our common eastern species, and indeed, even their relatives in various parts of Europe, Asia, and eastern Africa, that are also small striped ground-squirrels, are very similar in these respects.

Several years ago when writing about New Mexican squirrels (see Fig. 108) I said: Next, to form our acquaintance with the third and last species of squirrel which occurs in this region, let us, this balmy June afternoon, pick our way through the fallen timber and masses of loose rock that incumber the bottom of one of the vast cañons hereabouts. In such a place you seat yourself for a moment upon one of the rough and partly-imbedded sandstone boulders, which long since took its plunge adown the cañon side to its present resting ground. Here you will be obliged to wait patiently for some ten or fifteen minutes in perfect quiet, when in all probability your ears will then be saluted by a not unpleasing little chirrup, which but partly reminds you of a sound often heard in the old, familiar woodlands at home.

With your eyes accustomed to peering into the recesses of nature's material that goes to make up the side of one of the rugged cañon walls in this part of the country, you are soon enabled to discover the presence of the author of this "*chip-chip, chip ree, r-ree, r-reee, chip-r-r-rupp,*" for stealthily issuing from his hiding place and coming over a broad sandstone slab with little measured steps and many nervous twitches of his tail, which is held almost vertical, you behold the timid little Gila chipmunk, one of the most interesting representatives of an exceedingly interesting genus. If you sit perfectly motionless, another, then another will now soon make their appearance at different and unexpected points, until fully half a dozen of these engaging little creatures may be in sight at one time. But upon the slightest movement of your body, off they all scamper to the weather side of rock, root, or rubbish pile. You are not inclined to wait, however, another quarter of an hour, or perhaps longer, for a specimen, and as a fine male, bolder than the rest, has not taken part in the first general rush of the stampede, but stands displaying the pretty mixed gray of his back and the bright, though dark, fox color of the under side of his handsome tail, you awake the echo of the place as you fire a load of dust shot up in his direction. He is yours with hardly a visible mark upon him to indicate the cause of his so suddenly pitching down among the rocks, a *Tamias a. dorsalis* stone dead.

This chipmunk is a very different appearing little animal from his more handsome congener of the Eastern States *(T. striatus)*. And although the markings, as will be seen in the figure, are quite distinct upon his head, the broad, diffuse stripes down his back, on the other hand, are but feebly defined, and hardly noticeable in some female specimens. He is of a dull ocherish, clay color beneath, and a brownish-gray on the back, while, as I have already said, the under side of the tail is a reddish chestnut shade, that extends to the nether aspect of the flank, on either side, where it merges with the color already described for the lower parts, beyond. In March here, I have found the females of this species heavy with young, and in May these latter are fully two-thirds the size of the adults. So I am inclined to think that they raise two litters and perhaps three in a single season.

Other ground squirrels of this country belong to the genus *Spermophilus*, one rich in species and subspecies, and of these I have written not a little in other places, so they will not receive especial attention in this chapter.

It is the genus *Sciurus*, however, that contains the true specific and subspecific forms of squirrels. In it we find the numerous kinds of Red squirrels or Chickarees; the Gray squirrels; Fox squirrels; Abert's squirrel, and a number of others.

The Red squirrels are so well known as to obviate the necessity of any detailed description. There are several well-marked specific and subspecific forms of them in the United States, and doubtless a few geographical races yet remain to be discovered and described. In conversation with Mr. Robert Ridgway, the distinguished ornithologist, a short time since, he said he believed that the Red squirrel was one of the very worst enemies that the small birds of this country had to contend against. They not only destroy nests, but they will also suck birds' eggs and devour their young. Mr. Ridgway lives at his country-seat very near the city of Washington, D. C., and every spring not a few of the more abundant birds, such as robins, catbirds, vireos, and the like breed on his place. He noticed that the nests of these species were often destroyed, and in the absence of cats, crows, weasels, and other predacious forms he could not account for the destruction of their nests and eggs. One day, however, the various robberies of the kind were made clear by discovering a pair of Red squirrels in such a position that it left no doubt whatever in his mind but what they were the authors of it. He also said that on another occasion, in Illinois, he knew of a river that had greatly overflowed its banks for a long time, and through this inundation many large trees were killed on the banks. In the trunks of these, numerous woodpeckers had made nest-holes which had subsequently been abandoned, and in them a colony of Purple Grackles had built. One day while collecting in the vicinity he noticed a big Fox squirrel coming out of one of the holes in one of these trees with a young Grackle in its mouth, and there is no question but what the animal made a meal of its capture.

In my opinion all of the rodents in this country, and doubtless elsewhere, are flesh-eaters, and will eat raw meat whenever the opportunity offers. A number of years ago in New Mexico, I had as pets a litter of Prairie marmots, which as they grew older I accidently discovered were extremely fond of raw beef, and would eat it in preference to any other kind of food. It is a well-known fact of course that rats and mice (domesticated rodents), will consume meat uncooked whenever they get the chance to do so. Muskrats eat mussels *(Unios)*, and the male of tame rabbits will eat their own progeny.

Gray squirrels are considered to be by sportsmen legitimate game, and much has been written about their habits and the hunting of them. There is a black variety of this species, as well as several subspecific forms of it. Albinos are also occasionally met with; I saw a beautiful example of one of these latter collected a good many years ago in the Catskill Mountains of New York State. There is a northern and southern variety *(Sciurus carolinensis leucotis* and *S. c. carolinensis)*. "The most remarkable feature in this species of squirrel," says a popular writer, "is its occasional migrations, in great multitudes, over mountains and streams, across cleared fields and dense woods, seeming to be guided by some necessity as to food, or some imperious but inscrutable instinct." Marvelous accounts of these migrations have been given us by those who have had the good fortune to witness one of them. Lapland Lemmings perform similar migrations, and the reason for them may be an inherited impulse dating back perhaps to the fluctuations of climate during the glacial epoch.

In New Mexico, I had abundant opportunity to study in nature those elegant forms of United States *Sciuridæ*, the Arizona and Abert's Squirrels. The latter, as to the entire upper parts, are of a grizzly iron gray. Lower halves of inner aspects of ear-tufts, and a median broad stripe from shoulders to near root of tail, of a brilliant chestnut. Ear-tufts large, composed of straight black hairs. Entire under parts, borders of tail, circumocular stripe, and upper sides of feet, pure white. A rather broad dividing line at either side, between white of under parts and gray above,

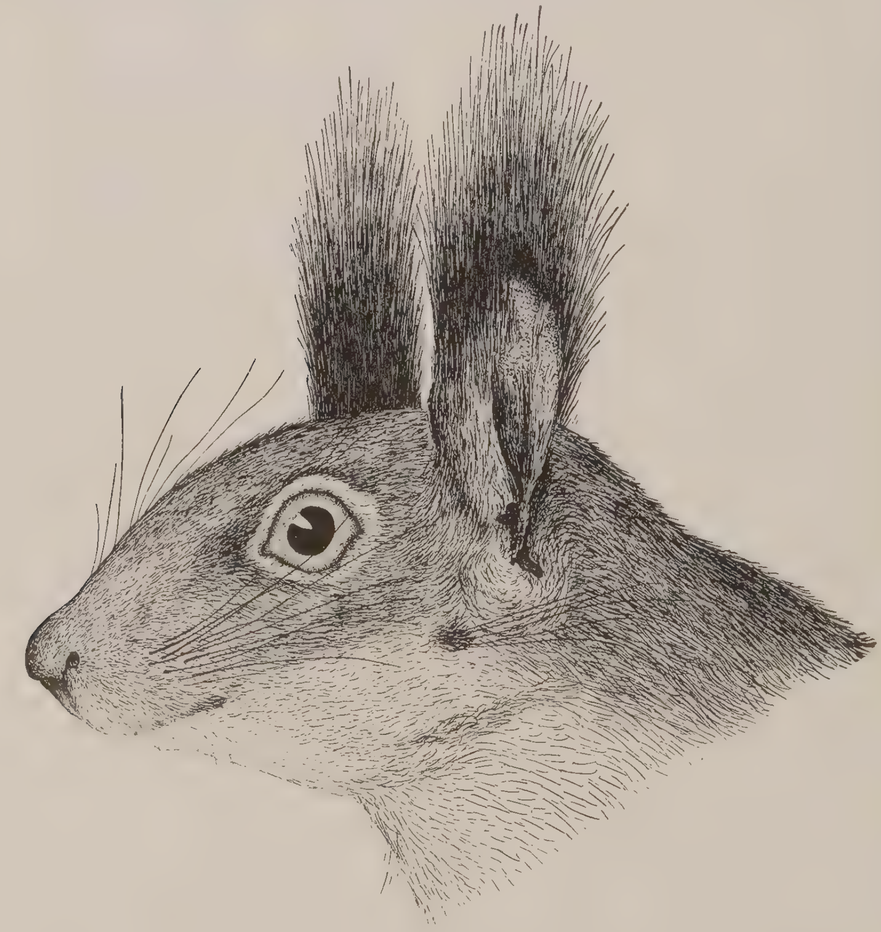

FIG. 109. LIFE-SIZE HEAD OF A SPECIMEN OF ABERT'S SQUIRREL.
Adult Female.

jetty black. Central hairs of tail for its entire length, also black, forming a mid-third stripe down the member. Claws, horn-color and curved. Whiskers composed of six to ten black stiff hairs. (See Fig. 109.)

There is a splendid black phase or variety of this squirrel which is also said to occur in that region, but I never had the fortune to meet with one. However, I have seen very dark gray ones which are really wonderfully handsome animals, as the white parts in them are generally purer, and the specimens improved by the contrast in the colors, which of course is still more decided when they are only snowy white and jetty black, which is said to be the case in the varieties.

They say that the California gray squirrel *(S. fossor)* is even a handsomer animal than Abert's, but never having collected the former it becomes impossible for me to express an opinion upon this point, though it is hard to believe that anything in the shape of a squirrel could surpass the present species in its spirited aspect, its grace and beauty, and then, too, it is one of our largest varieties, which also adds to its otherwise fine appearance.

Abert's squirrel is fairly abundant in the high pines which occur upon the mountain-sides, principally to the northward and eastward of Fort Wingate, New Mexico, and they have been frequently taken within a mile of the station. A good hunter once told me that he shot nine of them in two days, all within five miles of this locality, and only hunted for them a few hours each day.

The animal is essentially a tree lover, and rarely spends any length of time upon the ground. If you suddenly surprise one in the forest, it immediately seeks the nearest and largest pine tree within its reach by a series of very active jumps and skips, to ascend it with great rapidity to the first branches, where it often stops to take a glance at the intruder, thereby frequently affording the gunner a capital opportunity to bag the specimen.

Now of the Arizona squirrel I have collected a number of specimens during my stay in those parts, and it is not infrequently seen within the immediate precincts of the station. In appearance it far more reminds one of our favorite gray squirrel of the East. It lacks the ear-tufts, and differs markedly from the common gray squirrel in being more of a grizzly color above, and a mixed tawny one beneath. As to its comparative size I cannot speak with certainty, although I am inclined to believe, from recollection only, that it is rather smaller than the average gray squirrel of the Eastern States. It likewise has a broadish chestnut band rather than a stripe, down its dorsal aspect, between neck and root of tail. This latter coloration is but feebly marked sometimes, when a glance at the animal leaves the impression upon one's mind that it is of an ocherish color all over.

Unlike Abert's, the Arizona squirrel is rather partial to the crests and side-walls of the great cañons of that country, and is very much of a ground squirrel, rarely resorting to the trees when surprised by the hunter. Indeed, in recalling my captures of him, I fail to recollect an instance of ever having seen more than one in a tree, while on the other hand, I have frequently shot them as they skipped ahead of me on the ground, or clambered up the cañon-wall above me. My observations, too, incline me to suspect that this squirrel always rears its young in a hole, often dug in the side of a clay bank, or some similar locality; whereas I suspect the nest of the Abert's squirrel is placed up among the pine boughs, as is the habit of our gray one. In fact I have observed nests in the pine trees here, which I have taken to be the habitations constructed by *Sciurus aberti*, as they were evidently the handiwork of some representative of that genus of animals.

CHAPTER XXVII.

THE DEER MOUSE, WITH NOTES ON OTHER RODENTS.

(Peromyscus leucopus: Rodentia.)

FEW of the smaller mammals of this country are better known to the frequenter of our fields and forests than the common little White-footed mouse. This very pretty little rodent is likewise known in various localities by the name of the Deer mouse or sometimes as the Field mouse. It has all over the world a perfect host of relatives, both near and remote, and even in the United States alone the number of species of ferine mice are many, not a few of which belong to the same genus that contains our present subject. It has only been within comparatively recent years, however, that many of the types and forms of our mammals of the size of a Deer mouse have come to the knowledge of science, and this has been greatly facilitated by the use of a variety of small spring traps, which are set in numbers in the runways made by these little animals in the localities they haunt. By this means naturalists have taken numerous mice, shrews, and their allies, hitherto unknown to them, and the systematic use of such traps in the unexplored regions of foreign countries will undoubtedly result in the capture of a perfect legion of small mammals, the presence of which, in former explorations, has been never so much as suspected by the collector.

A Deer mouse is but a little larger than a specimen of our common House mouse, and is at the same time a very different appearing animal, being of an ochre brown above, with all the lower parts and feet pure white. It is from this latter circumstance that it gets its specific name of *leucopus*. Their ears are rather large, and their eyes are markedly so, and very prominent and bright. Many of the members of this genus have the ears strikingly large, but none more so, I believe, than True's mouse, a form first described by the writer in New Mexico some ten years ago. (See Fig. 110.) Deer mice very rarely get into our dwellings, where the House mice have for so many ages been domiciled, but if we repair to any cornfield in the autumn time, and turn over a corn shock or two, we are pretty sure to find among the various species of mouse thus taken by surprise, a Deer mouse or so. They can be recognized at once by their big eyes and their white under parts. Of course, in making this statement, I refer to only such parts of the United States or elsewhere where the Deer mice are geographically distributed. When I was a boy and lived on Long Island Sound in southwestern Connecticut, we used to capture them in small figure-of-4 traps, and most interesting little pets they made when properly cared for.

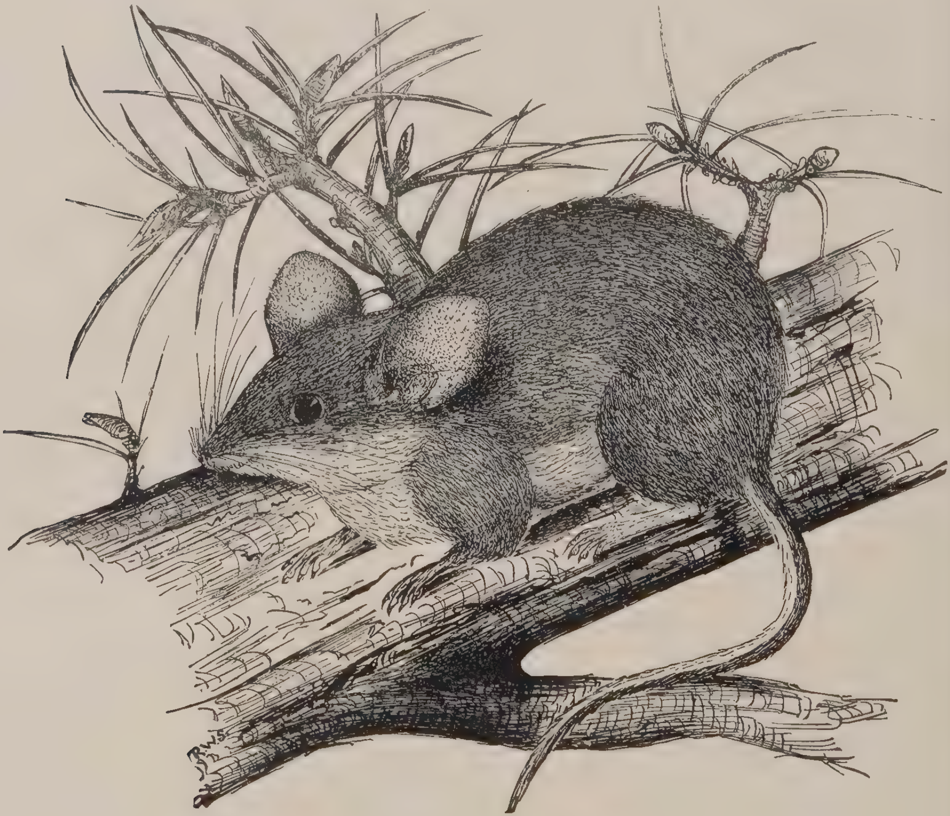

Fig. 110. True's Pinon Mouse (*P. truei*).

Life size from nature

During the spring of 1896, at my home here near Washington, D. C., while superintending the felling of a large poplar tree, the victim of a hurricane that a few days before had swept the country, my son captured one of these mice. He was in the tree at the time, when the mouse was disturbed at its roots by the axman; it

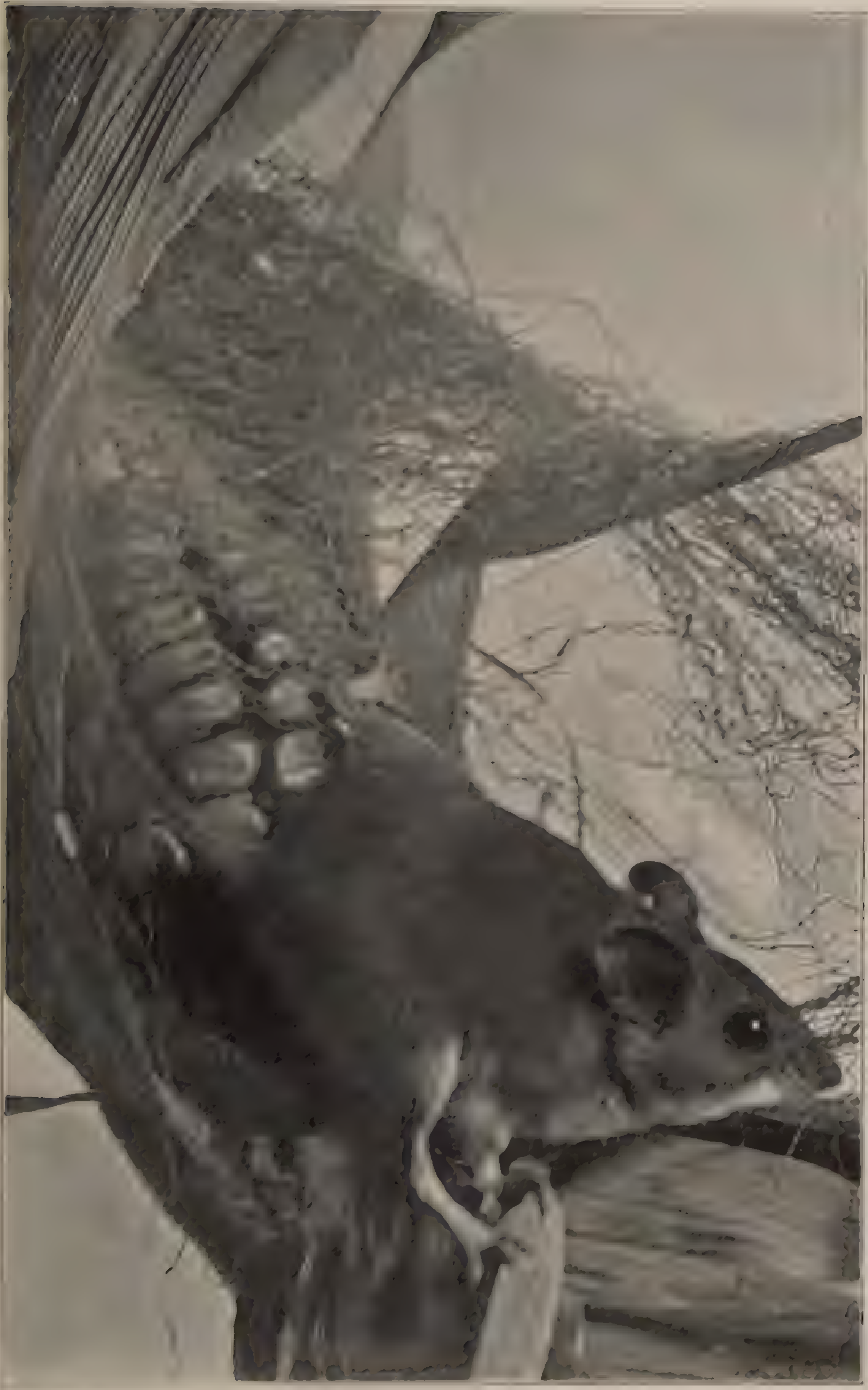

FIG. 111. THE DEER MOUSE (*Peromyscus leucopus*).

Subadult ♂, natural size. From a photograph of living specimen by the Author.

immediately ran up the tall tree, a feat it performed two or three times, racing up and down, before it was adroitly taken by my boy as it attempted to get out upon one of the broken lower limbs. This specimen is now before me alive, and I take it to be a subadult individual, inasmuch as its fur above is of a dark gray, the color assumed by the coat in the young animals of this species. In a small box it soon made a fine nest of tow, and seemed to be perfectly content with a little water and a store of yellow corn. The day following its capture I succeeded in getting a very good photograph of my prisoner, and a copy of this is reproduced here as an illustration to the present chapter. He ran down an ear of corn for me and was just prepared to jump when my faithful camera caught him in the act.

These mice usually build a nest in some old decayed stump of a tree or other in the fields or forests. It is made principally of the slivers of the bark of the cedar tree, and lined with soft grasses and similar material. They may also use corn silk, or occasionally leaves, and the like. These nests are also built in other localities, as up in some old red cedar tree, or in a vacated hole of woodpecker or flying squirrel. When built up in a small tree they have the appearance of a somewhat large, roundish mass of the materials above mentioned, with a small hole in one side for the owner to pass in and out. Not infrequently I have captured these mice, and the four or five young they usually have at a litter, by cautiously climbing the tree and then grabbing the entire nest, being careful to slap my gloved hand over the entrance hole in so doing.

In the winter time, after a light fall of snow, if we go into the woods or meadows, it is not hard to find in suitable places tracks upon tracks of these little animals. They lead up some of the trees, or into stumps, or to holes in the snow, where they have gone down for food. They feed principally upon grains and numerous kinds of seeds, and it is said they often hoard up a quantity of corn for consumption during the winter months. Unlike some others of their kin, however, the deer mice never seem to pass fully into a dormant state, and thus hibernate during the cold part of the year, for we find evidences of their activity at all seasons. Farmers claim they are the source of a deal of harm in their corn and grain fields; and yet these very farmers shoot without discrimination every hawk and owl that comes in their way. Yet were it not for certain species of these raptorial birds, constantly feeding as they do upon small rodents of every description, the farmers' lands would literally be overrun with field mice, and the raising of grain thus be rendered almost futile. It may be said here, in fact, that the direst enemies the deer mice have are hawks and owls, and these birds, especially at such times as when rearing their young, capture and consume almost incredible numbers of them. Some snakes, weasels, and other animals also prey upon Deer mice, but all of these put together by no manner of means are as responsible for keeping their undue increase in check as are certain hawks and owls.

These Deer mice are chiefly nocturnal in habit, and are but rarely seen by men during the daytime, unless special search is made for them in their hiding places. In confinement they become very gentle and tame, and I have seen it stated in various popular works that when kept in cages they will at times sit upon their haunches and give vent to certain low and peculiar singing notes. This accomplishment has never been noticed in them by the present writer, though I have known the female of the common House mouse thus to "sing" during the time she has been giving birth to her litter. Upon one occasion I personally observed a case of this kind, the very distinctly audible notes inciting me to make search in a drawer containing house linen. Here, by cautious search, I discovered a female House mouse, with two newly born young beneath her. Upon being exposed, the "notes" ceased, and she ran in among the napkins and table cloths. An hour or so later the "singing" again attracted my attention, and upon going directly to the same spot, the mother mouse was once more surprised, and this time her litter had been increased by the addition of two or three more young ones.

Deer mice, in common with their other near relatives, are extremely nervous creatures, and upon the occurence of sudden sharp sounds in their immediate neighborhood, they will lay back their ears, jump several inches off their feet, and at the same time protruding their eyeballs, as if those organs were about to pop clean out of their sockets. For short distances they can swim well, but just so soon as the fur gets thoroughly wet, they become exhausted and soon drown. When in the trees, Deer mice are good leapers, and by this means make rapid progress in passing among the smaller limbs and twigs.

Notwithstanding the extreme abundance of these little animals, and the great length of time they have been known to us, we are still quite ignorant of much that pertains to their natural history, and the young naturalists of this country can employ their time in no better way than to make personal observations upon the habits of these and other representatives of our mammalian fauna, recording every fact noted that may in any manner increase our knowledge of their biology in any one of its departments.

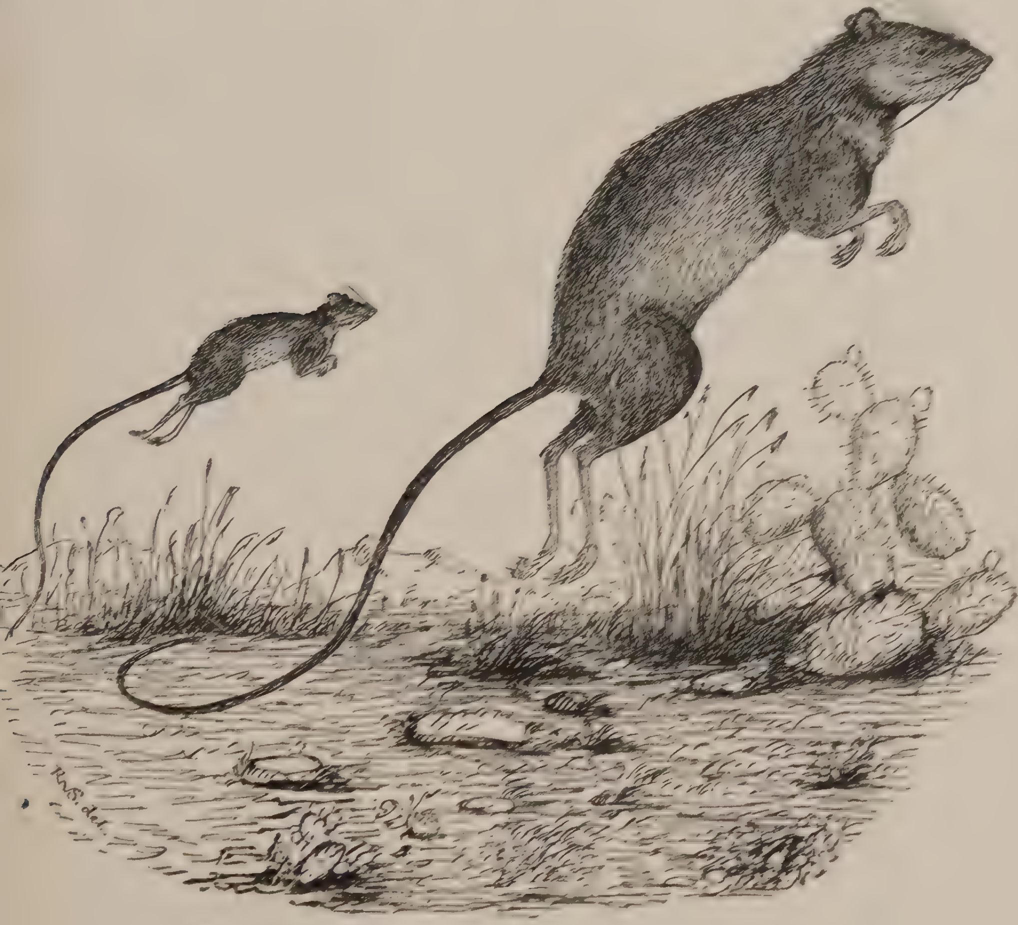

FIG. 112. THE JUMPING MOUSE (*Z. hudsonius*).

Adult male.

Several years ago when I wrote about the Jumping mice of this country, *Zapus hudsonius*, the Jumping mouse was the sole species of the only genus of the family *Zapodidæ* of the order Rodentia. This interesting little animal measures from tip to tip, when adult, between seven and eight inches, the tail being considerably longer than the body. It is white on its lower parts, while on the back and superior aspects it is of a reddish brown. Ranging over North America generally, although nowhere abundant, it is known in some localities as the Canada jerboa, it having much the appearance of one of those animals, with its long hind and short forelegs, and its power of taking long leaps. Mr. Abbott, in comparing the habits of hibernation of the Deer mouse *(P. leucopus)* with *Zapus*, says: "These two mice, popularly so called, hibernate with regularity in one sense, but differ *inter se* in another. The former *(Zapus)* once torpid, remains so until spring, a few warm days in winter failing to rouse them; but the White-footed mouse seems simply to sleep soundly rather than grow torpid, and responds with considerable promptness to any disturbance. The Jumping mouse builds a nest of leaves and grass at a comfortable depth from the surface of the ground (not a 'ball of mud,' as stated in the Encyclopædia Britannica, Art. 'Jerboa'), and, once fairly settled therein, is beyond the various sudden changes of our winters; the White-footed mouse, on the contrary, utilizes an old bird's nest, or has a nesting place beneath a log or in a half-decayed stump. In such positions, of course, the occupant is more likely to be disturbed, and is also directly exposed to the varying temperature. Is it to meet the requirements of his condition that this mouse lays up a goodly stock of food during the autumn? Something the jerboa, or jumping mouse, does not do. However this may be, the fact remains, that both these rodents are quite sensitive to cold, and hibernate as soon as the winter sets in; yet how differently is this faculty exercised!"

Zapus may have several litters during a summer, and the female bring forth from three to four each time. Sometimes the mother may be seen dragging her semi-hairless progeny along, bumping them over the ground as they hang on like grim death to her teats. This animal in leaping takes a course in zigzags, clearing two or three yards at a time, springing with its hind feet, but landing on its fore feet at each bound. Farmers sometimes plow it up in their wheat fields, when it makes off in magnificent leaps. It feeds on grain and various kinds of seeds, but rarely does much damage. Strictly nocturnal in its habits, it may be found haunting either the woods or the open cultivated fields. Smaller by all odds than many of its kin in foreign lands, it is when captured found to be a gentle and timid little creature, that, with pains and care, is soon broken to domestication and makes a very interesting little pet.

All of our United States mice belong to the Family *Muridæ*, a group that likewise includes the Muskrats *(Fiber, Neofiber)*; the Lemmings *(Myodes)*; and the Cotton and Wood Rats *(Sigmodon, Neotoma)*. And, as has before been said, this family of the *Muridæ* belongs to the Order *Rodentia*, that includes, besides the Squirrels *(Sciuridæ)* and the Mice, the Jumping Mice *(Zapodidæ)*; the Porcupines *(Hystricidæ)*; the Pikas *(Lagomyidæ)*; and the Hares *(Leporidæ)*. Representatives of all of these families are to be found within the boundaries of the United States, while others of the Rodentia occur not only in Mexico and Central America, but the world's fauna at large offers as many more, and very remarkable rodentine families, containing many species and subspecies. Comparatively speaking, the order Rodentia is composed of mammals of small size, the largest form known to it being the famous Capybara *(Hydrochœrus capybara)* of South America, while some of the little pocket-mice represent, next to some shrews, the smallest of all known mammals. Rodents are mostly terrestrial forms rarely given to tree or aquatic life, and there are probably a thousand good species of them known to science, with a great many more yet to be discovered and described. Animals of this group have no canine teeth, and are readily known by their stout, chisel-shaped incisors, of which, with the exception of *Lagomorpha*, there are commonly two in each jaw, just as we find them in a squirrel. There are never more than two incisor teeth in the lower jaw in any rodent. These incisor teeth are very remarkable, growing as they do from persistent pulps, and without interruption. Their roots are long and curved, extending far back into the skull or the mandible, the aforesaid pulp from which they continually grow being at the hinder extremities, while their anterior, chisled ends are kept permanently sharp by the friction between the free edges of the upper and lower pair. From one cause or another it sometimes happens, as in the case of a rabbit or squirrel, that the opposing surfaces or edges are distorted, whereupon the misplaced tooth or teeth having no opposed one to wear it off, continues to grow on without interruption, and as the form of the tooth is curved, it usually grows backward into the mouth, sometimes causing the death of the animal. The molars or grinders may be rootless or the reverse, but are never numerous. Their positions are well-shown in my figure of the skulls of the Muskrat and Beaver, here given. In addition to

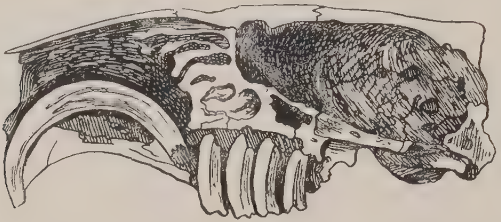

FIG. 113. VERTICAL, LONGITUDINAL SECTION THROUGH THE SKULL OF A BEAVER (*Castor fiber*).

Showing the central cavity, the greatly developed turbinal laminæ, the mode of implanation of the large, ever-growing, chisel-edged incisor, and the curved, rootless molars. Drawn by the Author after Flower.

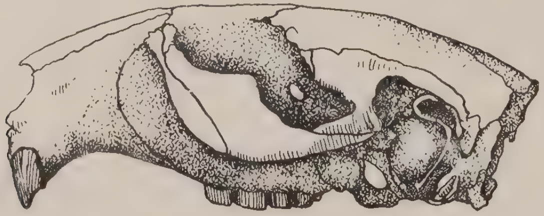

FIG. 114. SIDE VIEW OF THE SKULL OF A BEAVER (*Castor fiber*).

Lower jaw removed, showing teeth in the natural skull. Drawn by the Author after Huxley.

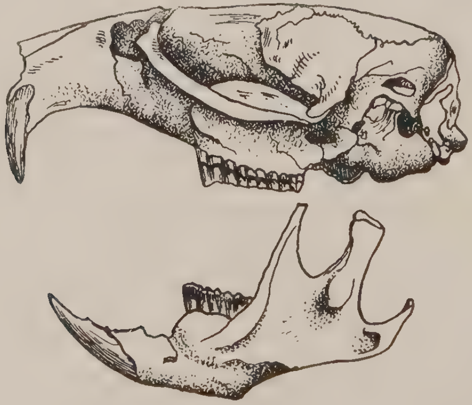

FIG. 115. SIDE VIEW OF THE SKULL OF A MUSKRAT (*Fiber zibethicus*).

these distinctive characters presented on the part of the teeth in rodents, they offer, as a whole, many other interesting and instructive anatomical structures and physiological functions. The arboreal squirrels have already been touched upon in another chapter; the cursorial Hares and Rabbits, are terrestrial types, although the Water hare found in Alabama *(Lepus aquaticus)* swims well. Some of the Mice are great jumpers, and their organization has become fitted to meet the surprising agility which they possess. Many rodents are almost typically fossorial, as the Moles and many others; while such forms as the Beavers and Muskrats are essentially of a natatorial habit.

In describing the mouth in the Rodentia, Sir William H. Flower has remarked that it is "divided into two cavities communicating by a constricted orifice an anterior, containing the large incisors, and a posterior, in which the molars are placed, the hairy integument of the face being continued inwards behind the incisors. This evidently prevents substances not intended for food getting into the mouth, as when the animal is engaged in gnawing through an obstacle. In the Hares and Pacas the inside of the cheeks is hairy, and in some species, as in the Pouched Rats and Hamsters, there are large internal cheek pouches, lined with the hairy integument, which open near the angles of the mouth and extend backwards behind the ears; in the New-World Pouched Rats (*Geomyidæ*) the pouches open externally on the cheeks."

Speaking of the Hares, it may be said that we have in this country many species and subspecies of them, all belonging to the family *Leporidæ;* but we have no true Rabbits, a name, which, by custom, has only been applied to the smaller variety of our Hares, as they so closely resemble the true Rabbits of the Old World. These latter by habit are gregarious, and are found in the open country, where they make burrows to live in. Their young are also born blind and naked, which is not the case with the Hares, which last are found only in cover of some sort or other, and never burrow, and are solitary by nature. The two species are also very different in appearance. *Lepus cuniculus* is the common wild rabbit of Europe, while our most common Cotton-tail is the *L. s. sylvaticus*, an animal so well known as to require no special description.

The Jackass Rabbits are large Hares found in immense numbers in the West and Southwest, and they afford excellent sport in hunting them with greyhounds. In some localities in California and Colorado these animals constitute a veritable pest to the agriculturists, and of recent years thousands of them have been destroyed in "drives," where many hunters have surrounded them and driven them into great pens or corrals to be subsequently killed by the hundreds.

Another family of rodents represented in the United States is the *Lagomyidæ* or the Pikas. It contains but the one genus, and our fauna, but the one species, *Lagomys princeps*, the North American Pika, or Little Chief Hare. This animal I have never succeeded in taking, though on numerous occasions in the Big Horn Mountains of Wyoming, I have heard its call. It seemed generally to come out on a pile of loose stones somewhere on the mountain side, most often toward sunset, and then utter a peculiar sharp little whistle of its own. I have seen old hunters deceived by this call, as at certain distances it does not sound very unlike the bleating of a Mountain sheep. Personally, I know but little about this particular rodent, but know it to be a vegetable feeder, and that there still remains much to be discovered in reference to its habits. *Lagomys* is derived from two words signifying a hare-mouse, and the few species in existence in other parts of the world are all small animals. Other interesting animals of our Rodentia are the Porcupines, and of these we have at least two good subspecies in the United States, and they present many interesting habits for study.

CHAPTER XXVIII.

BATS AND THEIR HABITS.

(Chiroptera.)

BATS form a restricted group of volant mammals constituting the order *Chiroptera (i.e.,* hand-winged). There are upward of one hundred and fifty species of them known to science, but of these perhaps not more than twenty-five of the smaller forms are found within the limits of the United States. It is in the tropical and subtropical regions of the earth, including the many islands of those latitudes wherein the larger species of these truly remarkable animals are found. On some islands bats are the only mammals met with, a fact easily accounted for when taken in connection with their extraordinary power of flight; a power made possible in them by the possession of the extension of a delicate membrane included between the greatly elongated and slender digits of the fore-limbs upon either side of the body. These membranes extend so as to reach the hind legs, while in some species they are even produced posteriorly so as to include the tail. This arrangement renders them extremely awkward in most cases in the matter of terrestrial locomotion, while it invariably insures movements in the air of the greatest ease and grace, unequaled by any other form that flies. In fact the entire economy of the animal is especially adapted to this power of aerial progression, and to the capture of their food in that element. As a rule, their organs of sight are but feebly developed with respect to size, but this is fully compensated for by their great keenness of hearing and smell, and to those keen senses must be added the high degree of tactual sense with which their wing-membranes are endowed. Indeed, in those experiments wherein bats have had the powers of hearing, sight, and smell practically destroyed, they find no difficulty in flying about and avoiding any obstacle met with in their course, and that too, with the greatest apparent ease. Some of the foreign bats are characterized by great development of the external ears; the peculiar leaf-like appendages surmounting the nose; or by the possession of tubular nostrils. In the Long-eared bat of Britain, for example, the external ears have a length equal to the entire length of the animal's body; in the Leaf-nosed bats the external nasal appendages are simply extraordinary, possessing a wonderful variety of forms and sizes, and of the keenest tactile sense. In fact, anatomically speaking, there is no order of existing mammals presenting a greater number of points of structural or morphological interest than do the representatives of this highly varied group. An entire volume, of goodly size, might with ease be written upon this subject alone.

In the early days when accounts of animals first came to be written, such naturalists as Pliny classified the bats with the birds, an error committed likewise by one of the authors of the Bible. Even at a much later day, Linnæus included them among the *Primates* with man and the Apes, chiefly for the reasons that the mammary glands were found upon the fore part of the chest; on account of the number of superior incisor teeth (four in many species); and that the organ of generation in the male was pendent. Numerous other naturalists, later on, followed suit, as a few similar structures in the organs of reproduction of the female were studied, but all these requirements were subsequently explained by zoölogists of more modern date, the position of the mammæ, for example, being evidently related to the position the young must assume during the flight of the mother. As a greater number of species came to be examined with stricter regard to anatomical detail, it remained, finally, for Professor Huxley to point out that the bats were nothing more nor less than extremely modified *Insectivora* with their structure almost wholly subservient to the power of flight. "So thoroughly, however, has this adaptation been carried out that," as Sir William Henry Flower says, "of all animals the bats are the least terrestrial, not one of them being equally well fitted, as most birds and insects are, for progression on the earth. This is due to the hind as well as the fore-limbs being pressed into the service of aerial locomotion. The hind limb is so rotated outwards by the wing-membrane that, contrary to what obtains in all other vertebrates, the knee is directed backwards, and corresponds in position to its serial homologue, the elbow. When placed on the ground, therefore, the animal rests on all fours, having the knees directed upwards like a grasshopper's, while, in order to bring the foot into a position for forward progression, it is rotated forwards and inwards, on the ankle. Walking under these circumstances is at best only a species of shuffle, and that this is fully recog-

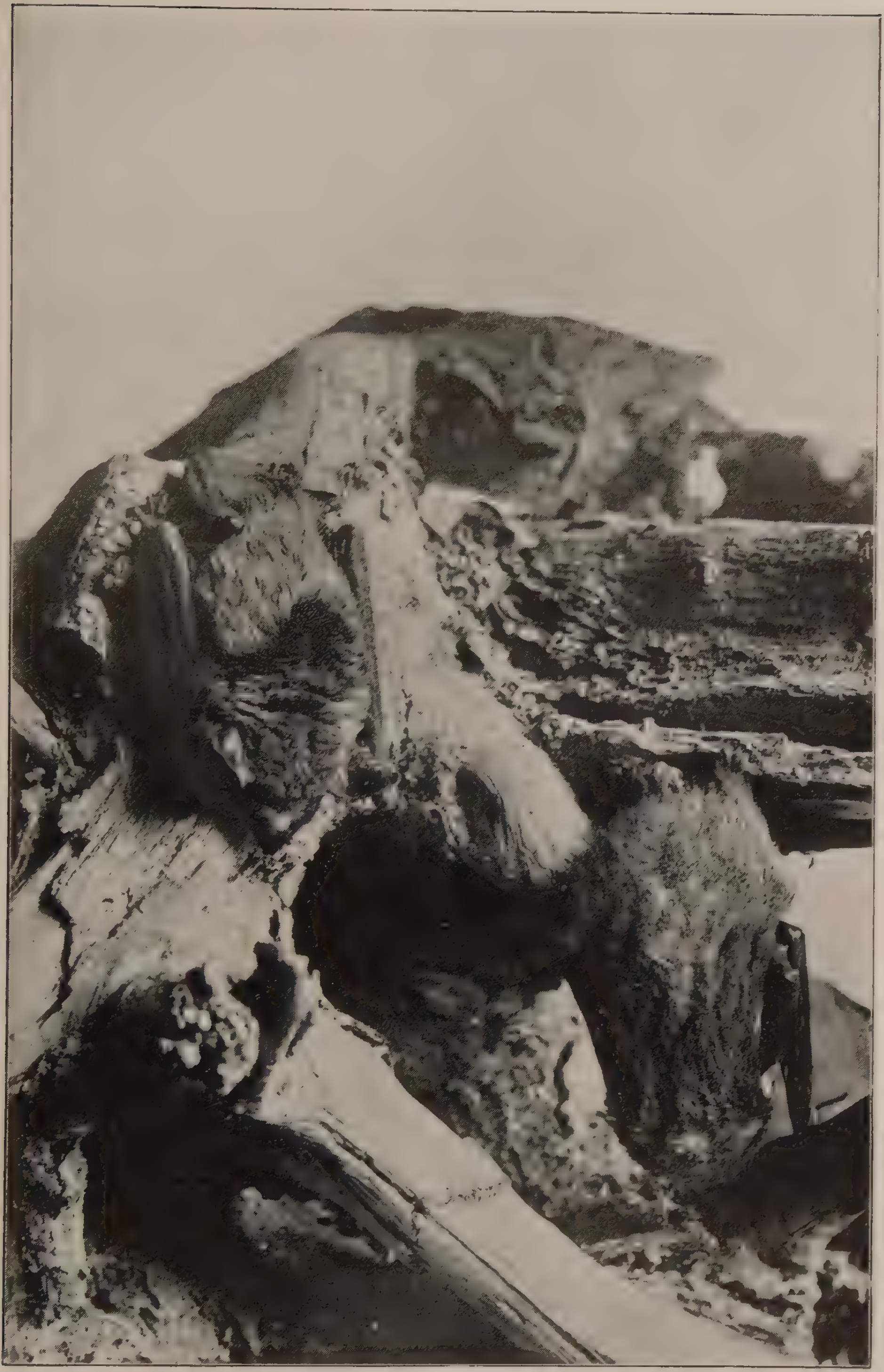

FIG. 116. BATS IN AN OLD TREE STUMP.

Upper one is the Serotine Bat (*Adelonyctirus fuscus*, ♂) and the lower one (suspended by the feet) is the Red Bat (*Atalapha borealis*, ♂) showing protective mimicry. Photographed natural size from life by the Author.

nized by the animal is evidenced by its great anxiety to take to the wing, or, if this be impracticable, to ascend to some point where it can hitch itself up by the claws of the hind legs in its usual position when at rest." With hints of this nature before us, the study of the skeleton in various species of bats becomes intensely interesting.

Mythological literature from the dawn of history has used the bat as the emblem of everything uncanny, it even having been made sacred to Proserpine, the Empress of Hell. Likewise, the animal has by the superstitions of all ages been regarded with the utmost dread and horror, or as a popular writer puts it, the "use of bats for these purposes is as old as Homer, who very skillfully manages them in heightening the graphic effect of the splendid passage in which he describes the shrieks and wailings of the ghosts in the regions of woe; and after Homer, all poets and painters who have ventured upon similar delineations have made use of the bats for the purposes of effect. Even to this day, painters must borrow the wings of bats for their devils, in the same way that they borrow the wings of doves for their angels; and one has only to throw a deep Rembrandt shade over a piece of canvas, and show a bat's wing partly displayed from a cave, in order to give an infernal air to it, and make it, with very little painting a good poetical representation of the gates of hell. It is easy to see how a race which is linked with such associations, should have had but a scanty measure of justice meted out to it by the half-superstitious naturalists of the Middle Ages; and a remnant of the same superstition is no doubt the cause of much of the horror which is still connected with some of the larger species of warm countries."

Modern science, however, is rapidly dissipating such ideas, and in time will eliminate them altogether.

Of the foreign bats we may note the great tailless, fruit-eating "Flying Foxes," of the East Indies, of the family *Pteropodidæ*, one species measuring five feet across its outstretched wings. This, also known as the Roussette bat (and allied forms), often congregate in vast numbers in the forests, and in settled parts do much damage. Their history is full of interest. Several other very remarkable genera belong to the same family. Then there are a large number of the Leaf-nosed bats, already alluded to, and the famous blood-suckers or Vampires, of both of which a great deal has been said and written.

Through the efforts of Peters, Dobson, Flower, Harrison Allen, and others the classification of the order is now upon a very good basis, and new forms from various parts of the world are constantly being added to it. Our small, insectivorous, and for the most part either nocturnal or crepuscular bats, in habit, all seem to fall within the suborder *Microchiroptera*, being confined to the families *Vespertilionidæ*, *Emballonuridæ*, while the Leaf-nosed bats (*Phyllostomidæ*) are found only beyond the southern border of the United States.

Of the first two mentioned families the writer has studied in nature and in the Museums not a few species belonging to them, and especially such forms as our little Red bat *(Atalapha borealis)*; the Serotine bat *(Adelonycteris fuscus)*; the Pale bat *(V. evotis)*; the Hoary bat *(A. cinerea)*; and a number of others. Many years ago I collected in New Orleans a remarkable species *(Nyctinomus* sp ?) that had a long tail like a mouse, and not included in any interfemoral membrane. It was very active on the ground, where its locomotory powers were good, thus forming an exception to the general rule. The Hoary bat has also been shot by me, when hunting its insect food during the brightest hours of noonday, and in the full rays of the sun. As a rule, however, all of our bats hide away during the daytime either in hollow trees, caves, fissures in rocks, or frequently in deserted buildings, or concealed open cavities in tenanted houses or public edifices; and in such structures as wooden bridges and elsewhere. Sometimes the number found in such places is enormous. The little Red bat, however, and other species seem to be satisfied to hang by its hinder feet, head downward, from the twigs of trees and shrubs, in which situations I have frequently taken it. When in large hosts and their hiding place somewhat confined, they will give vent to a variety of noises, hisses, and cheiropterine grunts when disturbed, and so great is the agitation sometimes that the temperature of the cavity will be elevated several degrees, a fact proved by the use of the thermometer. From these hiding-places they swarm out as evening comes on, and immediately proceed to hunt the insects upon which they subsist. Enormous numbers of highly noxious pests to man are thus nightly destroyed, in which pursuit the bats are a great benefit to us. Bats as a rule, breed during the hottest part of the year, and usually have two young at a birth. I have shot the female Red bat with a helpless, nearly hairless, young one at each breast, vigorously

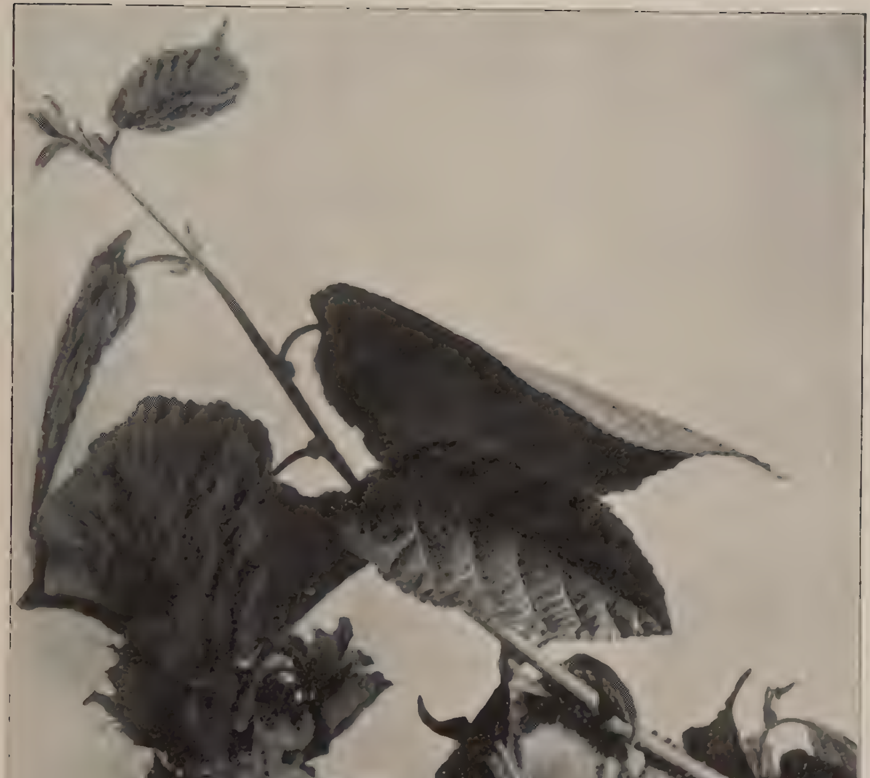

FIG. 117. SEROTINE BAT (*Adelonycteris fuscus*).

♂, natural size. Suspended upon a twig of Hazel bush (near nut); right lateral view; showing protective resemblance. Photographed from life by the Author.

nursing away, and holding on to the hair of the mother with a pertinacity, rivaling that of a young opossum. Harrison Allen has published some excellent studies of the reproduction of bats, that are of great importance, and we stand much in need of more literature of the same high standard. Bats never build any such a thing as a nest, so that their very helpless young when born must wholly rely upon the one supplied by the hair of the mother's breast as their only refuge. Occasionally, while nursing them, she will suspend herself in the usual way in her place of retreat, and allow them to take their food uninterrupted by her flight.

As evening comes on bats come out of their retreat in numbers, some to skim up and down the bypaths of the forests and glens; others take to the streets and lanes of cities, towns, and villages, while some species seem to prefer to do their entomological hunting far up in the air. Light invariably attracts them, owing to the number of insects that swarm about it. For this reason they are frequently seen flitting about the street lamps or even fly into our houses or other places brilliantly lit up during the hours of evening and later on. So among the town people in England, as also in some parts of this country, they are called Flitter-mice, and by the Germans *Fleder-mauser*, while I may add the French know them as *Chauve-souris*, or Ball-mice. They are, when flying about at dusk, easily shot with a light gun or collecting cane; or they may be taken with a hand-net. Boys about the street-lights frequently get them by tossing up little pebbles in the air, and as the bat flits down after what it supposes to be a beetle, it is knocked to the ground with a bushy bunch of leafy twigs in the hand of the juvenile collector. I have also taken them with a small fly-fishhook and line, flipped about skillfully in the air where they have been numerous, and hunting well some special locality.

During the winter, particularly in the North, our bats all hibernate in cavities in large bodies together; although some species, I believe, do the same singly or only a few together. Several times in the winter, if a warm day happen to come on, I have seen the Red bat come out and hunt with quite as much activity as though it were midsummer. Such sights, however, are but rarely seen.

Our Serotine bat is capable to a degree of being tamed, but as a rule they are vicious, cross, little creatures, that bite with vigor whenever handled. Most all of our species possess a musky smell about them, very strong under some circumstances, and very disagreeable to some people. When coming into our houses in the evening bats have been known to get into the hair of some lady present, generally by being knocked there by some male member of the family present, in his efforts to kill the specimen. When thus entangled, it requires skillful handling to get the poor frightened little creature free again, especially as the lady will often make the feat the more difficult by her agitation and screams. Foolish and thoughtless people, largely under the influence of superstition, have cut the hair away under such circumstances, a totally unnecessary procedure.

Just at this point I desire to say something about protective resemblance, or, as many naturalists have termed it, protective mimicry, as further on it is my intention to show how this important law of nature applies to the animals being considered in the present chapter.

It is a well-known fact that many of the living organic forms in the world, by their close resemblance to various objects in nature, are often hidden or made less conspicuous to their enemies, and so are protected and are preserved from extinction. Many insects closely imitate such natural objects as the bark of certain trees, various kinds of living or dead leaves, or stones, twigs, lichens, and so on, thus greatly enhancing the chances for their lives against enemies that are constantly in search of them for food. For example, I have seen one of our common moths resting with its wings closed upon the bark of any large forest tree, as a chestnut or oak, and so closely did its color and markings resemble that of the tree that it required the very closest scrutiny to discover it.

In the East Indies they have a small caterpillar that so closely resembles the form often seen in the droppings of birds, that it rests quite safe from molestation; and simply hundreds of other instances of protective mimicry might be given for all kinds of insects. But this law is also extended to representatives of every other group of animals of both the vertebrate and invertebrate divisions.

Again certain animals imitate others, which latter enjoy immunity from attack, and thus their imitators are protected likewise. Certain flies have such close resemblance to bees, both in the matter of form and coloration, that it serves them well in the matter of protection; especially when these flies likewise possess

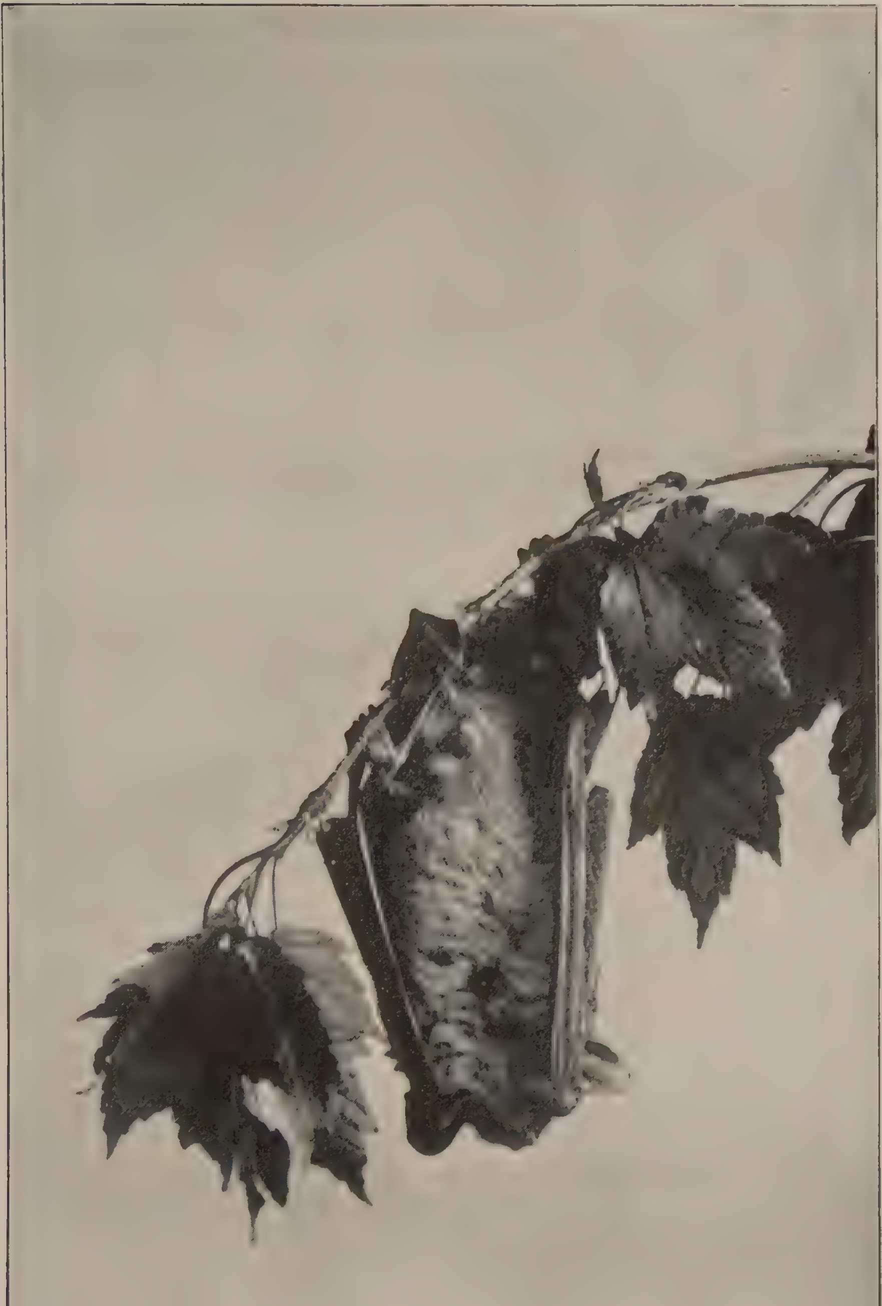

FIG. 118. SEROTINE BAT (*Adelonycteris fuscus*) ♂, Nat. Size.

Anterior view. Same specimen as in figure 117. On twig of maple. Photographed from life by the Author.

the power of even making the same buzzing that the bees do, producing it upon similar occasions. Did space allow, numerous examples of this variety of mimicry might be cited here.

Frequently certain animals are very obnoxious to others, for one reason or another; then these are seen to be very highly colored, or as we say, exhibit warning coloration. Our bright little Harlequin snake *(Elaps)* is a familiar example of this, and the skunk among mammals is very distinctly colored, and apparently on this account.

Just at this moment I do not happen to recall the name of a naturalist who has had anything to say about cases of protective mimicry in bats, yet it is frequently to be noticed. One warm evening last autumn I was passing through an extensive swamp, in which there was a close undergrowth of hazel, oaks, dwarf magnolias, and dogwood. Many of the leaves had already been changed to a great variety of shades of brown, bay, chestnut, and the like, and many had already fallen to the ground. For a moment I stood quiet with my gun to re-catch the note of a vireo that I had heard, but the bird had escaped me. The twigs of the undergrowth came very close to my face, and I had been peering among those of a small oak for several moments. By the command of the advancing season, many of its leaves were now curled up and changed to bright browns of divers shades, and at a passing glance one of these seemed to me to possess unusually black vein markings, and I reached out to pull it off its twig. All this took but the fraction of an instant, and just before my hand came in contact with this supposed-to-be leaf I discovered it to be a fine specimen of the male of our little Red bat *(Atalapha borealis)*. This little animal had been suspended within a yard of my face for certainly nearly ten minutes, and yet I had noticed it only as I came to move away. As it hung there by its feet, its resemblance to a dead and withered leaf was truly remarkable, and I studied this effect very closely before I secured the specimen.

Dr. A. K. Fisher, of the United States Agricultural Department at Washington, D. C., once told me of an interesting incident of this kind that happened to him. He was engaged in destroying caterpillars in a fruit tree, using for the purpose a long pole with a small fire-wad upon the end of it. Some of the caterpillars were in the dead and crumbled leaves, and these he was touching with the flame, passing from one to the other. In the course of this operation, and very much to his surprise, one of the supposed leaves, as it got its firing, instantly spread out a pair of black wings, and with an angry twitter made off with a singed coat. It was a Red bat that had been thus treated, and yet the doctor did not recognize it until it flew to escape a further scorching. Here was a case where protective mimicry did not help much.

Some of our bats have the hair of a beautiful snuff-brown color, as, for instance, the Serotine bat *(Adelonycteris fuscus)*, specimens of which I have kept for months at a time. These bats become so tame in confinement that they will both eat and drink while being held in the hand. In drinking they are very cunning, lapping the water up as they do with the tongue, after the fashion of a little dog. They drink a good deal, and have simply enormous appetites. One specimen in the course of a single night consumed twenty-one full grown June bugs *(Lachnosterna fusca)*, leaving only a few legs and the hard outside wing-sheaths (elytra) as evidences of his feast and gluttony. It was extremely interesting to watch him capture and devour one of these great buzzing beetles. Often I would serve him with as many as half a dozen at a time, but he always ate one up entirely before attacking a second victim. In holding his prey the interfemoral apron of the bat was frequently used, and sometimes he devoured an entire bug in the lap of it. I have heard it said that this bat also uses its apron during flight, as a net to catch the larger beetles which it feeds upon. By curving the membrane forward, as it notices a June beetle in its flight, it can easily scoop it in, and reaching forward, seize it with its teeth in an instant. When much alarmed, many of our smaller bats greatly protrude the eyeballs, even to a far greater extent than is seen in many small rodents.

Now, the Serotine bat very rarely suspends itself in the trees, although it occasionally does so. By far its most common practice is to hide away in old stumps, in crevices, and in old barns and similar places. When it does hang in a tree it may be easily mistaken for either a dead leaf or for the fruit. (See Figs. 116, 117, and 118.)

Personally I have never as yet been quite able to satisfy myself as to the chief enemies of the bats of the eastern part of the United States. Possibly the smaller carnivora may occasionally destroy them, or snakes, and under rare conditions perhaps they may be captured by certain hawks and owls. Man has every reason to protect them, as bats destroy simply millions of destructive insects. Yet the smaller species of temperate countries rarely seem to ever increase in number to any marked extent. To be sure, they have but one or two young at a time, and in the north breed but once during the season; yet with so few enemies, and man not in the list of these, one would think that the smaller species would become very numerous, especially in those localities where the majority of the conditions were favorable to them.

During recent years a number of new species and subspecies of bats have been added to the fauna of the United States, and doubtless not a few still remain to reward the search of the intelligent collector. This likewise applies to the discovery of the fossil remains of bats, as bones of insectivorous varieties of them have already been found in the tertiary deposits in various localities.

CHAPTER XXIX.

MUSEUMS AND THEIR USES: WITH SOME OBSERVATIONS ON TAXIDERMY.

IN this country, as in many other parts of the world, nearly all of our large cities support one or more museums, of one kind or another. Sometimes, too, we have private museums often built by some wealthy individual and devoted to the containment of special collections. Occasionally the public are given, upon certain days, access to these latter, and rarely is any charge made therefor. Whatever their pretensions may be, whether great or small, museums are the material manifestations of a variety of human desires. A collection of objects may be gotten together simply to gratify a taste to amass specimens of things curious, without any regard to instructive aims, classification, or naming by a system of labels. There seems to be an ever-present craving on the part of the public to see the unnatural, the odd, the uncanny, and the so-called freaks of nature. This trait is frequently taken advantage of by the mercenary, and collections are made simply to gratify it, with the sole purpose in view on the part of the collector or collectors to reap the pecuniary income derived from the enterprise. A large part of Barnum's success lay along upon these lines, exploited as they were, in his early days in New York City, upon a basis of unrivaled proportions. In the same category fall the pseudo-museums of anatomy, often, too, developed upon a grand scale, and in which are exhibited by life-size models every object inclined to gratify the taste for the morbid, the predilection for all that is horrible, and the gratification in a visual way, of all that is unchaste, and savors of pruriency. Apropos to this aspect of my subject, I would say that for many years past the War Department at Washington, D. C., has supported, upon a broad and extended basis, an Army Medical Museum, devoted to the exhibition of army surgery; anatomy, both pathological and normal; and, in short, anything scientifically illustrating the medical sciences. Years ago, I held the position of a curator in that museum, and was thus enabled to study the great number of people that daily passed through its halls. All came, both men and women, and I noticed that the great attraction was the cases containing the monstrosities, and, if I may so express myself—the usual unseeables—while, on the other hand, fine collections of comparative osteology, instruments, relief for the wounded, were passed by, by the masses, and were studied only by the few, the refined, and the progressive. While serving in the above capacity, I wrote quite an extensive memoir, entitled "Outlines for a Museum of Anatomy," and the same was duly published by the United States Bureau of Education in Washington. The objects advised to be brought together in this Museum were intended to fully illustrate, in every possible way, upon a morphological basis, the law of organic evolution, and that is a plan of museum we greatly need in all centers in this country. It was adopted by many colleges and other institutions of learning, greatly to the gratification of the hopes of its author—and that is one kind of a museum we should have in mind. Then there are museums devoted to such fields as those of manufactures and patents, of the evolution of arms, of inventions, of zoölogy in all of its departments, of botany, of coins, stamps, and other human conveniences; objects illustrating geology and paleontology, of ethnology, and indeed, of any other department of which the human mind takes cognizance, or into which human inquisitiveness has carried its researches. Of whatever the character the collection in any museum may be, however, it should always be based upon the furtherance of several closely allied subjects. These, although various, are akin. Above all else, the object of a museum should seek to instruct, to teach, to advance the natural progressiveness of the human mind. Its collections should be thoroughly illustrative of the department or field it represents. Its objects should be arranged in normal sequence and made comparative. For example, if the museum be an ornithological one, and ornithology has very largely been considered in the foregoing chapters of the present work, it should be shown or set forth at the very entrance to the room or rooms containing the collections, exactly what the science of ornithology, in its widest sense, purports to be. This can be conveniently done by means of properly printed labels, displayed in a methodical manner. Next in order should come a series of models, and such actual specimens as can be obtained, representing the origin of birds in paleontologic time, and their ascent from a stock common to their class and with that of reptiles. Here, too, a system of explanatory labels should be freely employed in connection with the specimens, as well as designs upon the walls giving the most recent conceptions of the avian genealogical tree. Exhibited next in sequence should be naturally mounted examples of the lowest forms of existing birds, with preparations of their skeletons, and other essential systems of their anatomy. The linkage of these forms with those now extinct should be clearly indicated, as, for example, in the case of the ostriches and the moas, the modern eagles with *Harpagornis*, the Loons with *Hesperornis*, and so on, down the entire line, for every natural group of the Class. These latter should follow next, the most lowly organized groups coming first, and all arranged upon a plan, whereby the bird itself was shown (male, female, and young), its seasonal changes, its structure, geographical distribution (by labels and maps), and, if any, its economical importance to man. The matter of affinity of the various natural groups can be largely shown by their juxtaposition in the exhibition rooms, and by explanatory labels. Too much importance cannot be attached to the free use of printed labels—clear concise, and instructive. Now this is an ideal outline for a typical museum, designed to illustrate one class of animals in zoölogy; it also represents the highest purposes and aims a museum can have—that is, the permanent preservation of material, arranged upon a plan capable of receiving additions and alterations, and the whole subservient to the ends of education of the people. Setting aside all other kinds of museums as not properly falling within the scope of the present work, it may be said that the same ideal plan should be applied to every other department of biology, and to geology. Taken as a whole, neither the people nor the government of the United States appreciate the necessity of creating and sustaining such educational institutions as these, but the time will come when they will. We have our museums, to be sure, but in these days they are more designed to serve as storehouses for material, rather than to meet the demands of education. The time is now ripe for the latter class; science is strong enough to throw off the yoke of myth and superstition, exemplified in a heterogeneous collection of mounted animals of any kind in her museums, arrayed upon a Noahchian basis, and to place in their stead scientific serial exhibits, that will present to the minds of the people the true manner in which organic life arose upon the surface of the globe. Not only this—its evolution—but its distribution, and thus to account for the fact why one country has one kind of a flora and fauna, and another country another kind.

But museums and the minds that give them birth and control them, evolve and develop as does anything else, and along these lines, every generation is marked by improvement and progress. With the future will come the ideal, educational museum of biology; and this being true, our interest in these institutions as they now exist should in no way be lessened. We should study them as they grow, and constantly help their evolution toward better ends, and their true purposes. In my lifetime I have studied a few of the zoölogical museums in our larger cities, and written about them, but circumstances have been such that the major share of my attention has been directed toward the National Museum, of Washington, including the Smithsonian Institution.

The Ornithological Hall of this latter is a very interesting room, and will well exemplify what I have just said above in regard to the present condition of modern museums in this country. Of this hall I am enabled to offer here an excellent picture, taken for me from the left-hand side of the end gallery at the east extremity of the room. This gallery corresponds with the one seen in the other end in the far distance in the picture. There, overhead, is suspended a California condor in the act of flight, while in the gallery itself are mounted specimens of various kinds of ostriches, the place being a passage from the long side galleries upon either hand. Of these, the south one is occupied by Mr. Ridgway and his assistants, while the one opposite is occupied by Mr. James E. Benedict, assistant curator of the department of marine invertebrates. Similar galleries occur on the eastern half of the hall, and these are for the conchologists, there being a part of the shell exhibit in cases down the entire midlength of the floor below, as may be observed in the illustration.

To this hall there are midway north and south entrances, while at the east end one passes by double doors into the executive part of the building, and at the opposite end into another very large exhibition department containing a superb display of corals, marine invertebrates, with fish, and casts of reptiles, and so on. Near this west end door there is a narrow stairway that leads up to Mr. Ridgway's corridor, and to one side of it a descending passage to the "west basement" below. In the former Mr. Ridgway does much of his work, and has there thousands of bird skins conveniently arranged in cased trays, and also the sectional ornithological library; while in the latter, besides vast supplies of other specimens and material, there are nearly 20,000 bird skins stored away in cases. This is a most unfortunate circumstance, as in such a situation this priceless collection is not only most inconveniently placed, but is far harder to defend against museum pests, and in the event of fire would surely all be lost. This reserve series of birds ought to be in a large, well-ventilated room by itself, and so arranged as to be thoroughly accessible. Indeed, another entire museum building is, and has been, a long standing need, and when this is obtained it is to be hoped that these splendid ornithological collections of the Government will be properly cared for and allotted a department to themselves.

As will be seen in my illustration, the cases containing the mounted birds in this hall are confined to alcoves between the columns, and below the corridors on the main floor. There are also numerous separate groups of great beauty arranged in other parts of the room, and in cases about the walls in the spacious vestibule to the south entrance. It will also be seen that, architecturally, this hall is quite imposing; it is also fairly well lighted in some places by large windows, while in others the sun's rays never gain access, and the recesses are gloomy beyond all description. Too much light in rooms where mounted series of birds are permanently kept is, of course, a bad thing, but, on the other hand, we ought to have sufficient to distinguish one bird from another at midday. Some of the birds in these cases are well mounted, especially those done in recent years; but again, in the older part of the exhibition series, the specimens have been prepared in the vilest possible manner imaginable, without any regard whatever to form, habits, or structure. These specimens stand sadly in need of a thorough going over and remounting by skilled taxidermical artists. (At this writing this is being done in a very satisfactory manner.)

Between the arches on the outside of the railing to the corridors, and in some places on the columns themselves, are hung various pictures of birds. Many of these are copies of Audubon's plates; some are Mr. Ridgway's originals; and there are some half dozen of Audubon's copper plates in frames, as the one of the scarlet ibis and others. The public entrance to this depart-

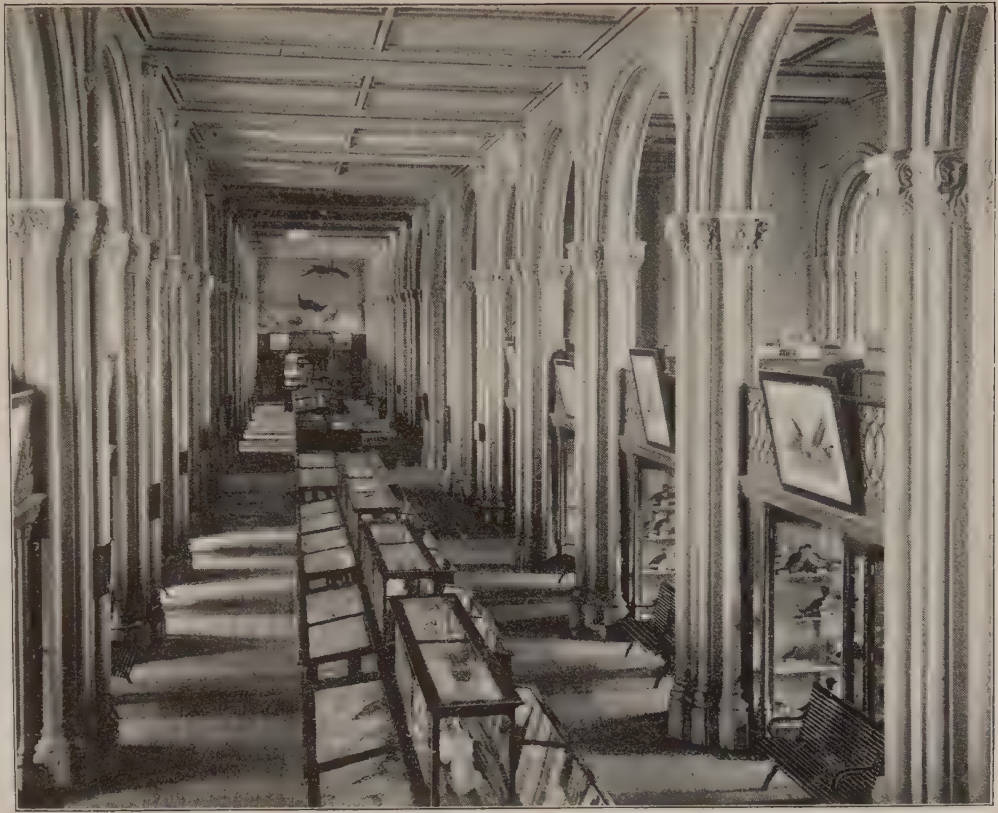

Fig. 119. Ornithological Hall of the Smithsonian Institution.

ment is through the north doorway, then the guard-room vestibule, north hallway, and under the sixth arch, counting on the right-hand side of the picture from east to west. The south doorway of the building is but rarely used, and not by the public within the writer's recollection.

One of the chief charms about this old Smithsonian hall, to me, is to reflect upon its history; to think of the many distinguished ornithologists and scientists who from time to time have trod upon its floors; to dwell upon the probable history of the many specimens of the birds in the cases (who collected them and where, and under what circumstances); and finally, to ponder upon what its future fate may be. It is over twenty years ago since I first put foot in this old time-honored hall, and for twenty years, off and on, I have passed through it pretty constantly. A few dozen of the mounted birds in the cases are of my own collecting, and I know of other bits of history pertaining to its somber alcoves that would make very interesting reading, but we will defer that to some other time, and likely, too, to some other place.

I shall conclude the present chapter with a few general remarks upon the taxidermy of certain mammals, birds, and fish. A few years ago the United States National Museum published for me, with nearly one hundred full-page plates, my work upon "Scientific Taxidermy for Museums," and in that memoir the systems of taxidermy employed in this country were quite fully discussed, so in the present place, as a means of comparison, I will direct my attention to the work in Europe, exemplifying the better class of it by what has recently been accomplished in the Leyden Museum, of Leyden, Holland. I am the better prepared to do this inasmuch as Mr. H. H. ter Meer, Jr., the taxidermist of that institution, has kindly sent me many photographs of the pieces he has mounted, as well as some of those done by his father, Mr. H. H. ter Meer, Sr., who shares his labors with him. Several of these photographs will be reproduced here, with brief criticism upon them, and also a little of the natural history of the animals themselves, which is quite entertaining. After the skin has been removed and prepared, Mr. ter Meer makes a model of the external form of the larger specimens out of a composition known fully only to himself. Peat enters very largely into this material, and it is of such a consistency that all the muscles and external parts can be exactly copied, while at the same time a perfectly lifelike attitude can be given to the form, as designed by the taxidermic artist. Over this the skin is placed and fastened by methods that subsequently give it all the appearance of the animal or specimen in life. I cannot in a brief chapter give all the details necessary to accomplish this, nor the great care and skill it demands, but after many years of experimentation the artisans of the Leyden Museum have reduced this operation to a positive science, and in most cases, as will be seen later on, the results are extremely satisfactory.

One of the most recent achievements in this direction has been the mounting of a remarkably fine specimen of that most extraordinary of fishes, the Sunfish. I refer to the *Mola rotunda* of Cuvier, the *Orthagoriscus mola* of some authors, the *O. nasus* of others. In operating upon this specimen, the first step taken was to secure as good a photograph as could be obtained of the dead fish after it came into the hands of the taxidermists. Next, before the specimen was skinned, an accurate outline was made—a most important step in the procedure. Then, in much reduced size, the fish was modeled in clay, and from that model the specimen was reproduced (after being skinned) in the aforesaid material, the interior of this last model being left hollow, in order to render it as light as possible. This model resembles exactly the skinned fish, and over it the skin was placed, with every necessary precaution to reproduce the animal as it appeared in life. Thousands of pins were used to make the skin fit properly into the sulci among the various muscles and elsewhere; the internal surface of skin being first poisoned with a preparation of dextrine, arsenic, and water, so that after the pins were removed the skin retained the exact position on the model that had been given it through their use. Finally, after the skin had become thoroughly dry it was tinted with the proper pigments, so as to lend to it the original color the fish had when alive. The setting of the artificial eye, the restoration of the mouth parts and fins, of course, all require the special care of the artist and make due demands upon his skill.

Owing to the fact that there are certain osseous formations in the skin at the snout, in the neighborhood of the pectoral fins, and the free margins of the tail, the model in these situations does not exactly agree in outline with the mounted specimen.

This preparation has been adversely criticised by some American taxidermists, who claim that the longitudinal wrinkles shown in the piece behind and below the pectoral fin, are of postmortem origin, and do not exist in the living fish. They are certainly not shown in Gorde's fine figure of this form (Plate 35. The Fishery Industries of the United States).

The specimen in the Leyden Museum measured from the tip of the snout to the extremity of the tail 184 centimeters, and from the tip of the dorsal fin to the tip of the anal fin 218 centimeters, making it a fish of by no means an insignificant size. And, to tell the truth, these Sunfish do attain to proportions not to be despised, for, according to Goode, one was brought to the San Francisco market some years ago that weighed no less than 636 pounds.

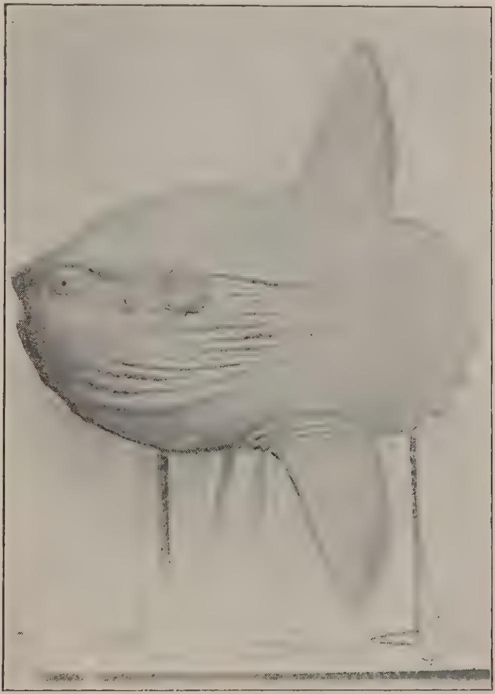

FIG. 120. MODEL OF SUNFISH, READY TO RECEIVE THE SKIN.
Prepared and photographed by Mr. H. H. ter Meer, Jr.

The Sunfish belongs to the family *Orthagoriscidæ*, and it is claimed that two species of them occur in the western Atlantic, the common one being *O. mola*. Headfish is the vernacular name for them in many localities, though Sunfish is the more common one. They have acquired the latter appellation from the habit they possess of lazily floating at the surface of the sea in a flatwise position, the whole glistening side of the creature being just below the surface of the water. As thus engaged the waves break over them, and the pectoral fin of the uppermost side is languidly waved to and fro in the air. A dozen or more may thus be seen from the deck of one's boat during the course of a day almost anywhere along our coast, and owing to their conspicuous size, that, too, at a considerable distance off. Many fishermen find sport in harpooning them as they float in this manner, and the ponderous fellows make no mean struggle for life afterward. I have also read accounts of hunting them aboard a yacht or steam launch with a heavy rifle or carbine. At such times ten or a dozen of them are started, and swimming in the vertical attitudes, offer no easy mark for the riflemen, as they are pursued in their wake. When thus swimming the dorsal portion of the fish's body is above the surface of the water, and its great dorsal fin forms a very conspicuous object.

Big Sunfishes may attain a length of at least eight feet and weigh as much as 800 pounds; but after one has captured a specimen, it is fit for nothing, except to study, look at, and wonder about. Goode says the " flesh is thin and hard, and, when cooked, separates into oil and bunches of tough fibers." As long ago as 1740 Dr. Barlow, an Englishman, suggested making glue of them, but his bright idea seems never to have been carried out. At Cape Cod the fishermen extract the oil from the livers of Sunfish and believe there is nothing equal to it as a remedy for contusions and sprains.

In life the skin of the Sunfish has a brilliant silvery appearance, and at night is said to be highly phosphorescent. Some people say that this is the reason it has been called Sunfish, or Moonfish, as others name it. Jellyfish, or Sunsqualls, are consumed by them in great numbers, but as they are endowed with powerful mandibles, it is by no means unlikely that they also seek tougher foods. So far as the writer is aware, and unless the knowledge has been recently acquired, we are utterly ignorant as yet of the breeding habits of Mola, or even the localities frequented by them for that purpose; every once in a while a young one is captured, and that in mid-ocean. Although I sailed for an

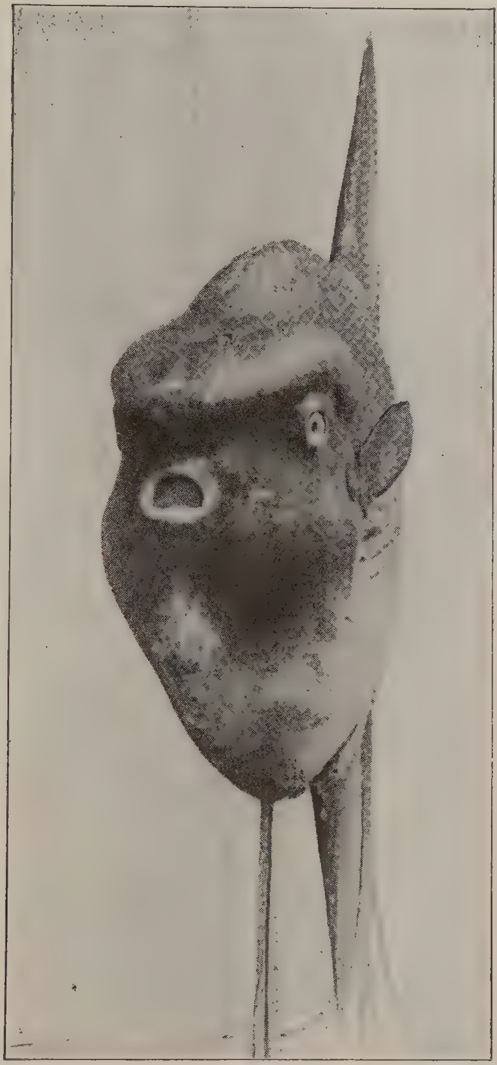

Fig. 121. Anterior View of Mounted Sunfish.

Same specimen as shown in Fig. 122.

entire year in the Gulf of Mexico, I never observed a Sunfish in those seas, and do not believe they occur there; indeed, it is said that it is not until we come to the coasts of New England—and that, too, in the summer-time—before we begin to meet with them. According to Dr. Goode two large specimens were captured at the mouth of the Saint John's river, Florida, during the winter of 1874-75. With certain exceptions then, the Mola is pretty generally distributed throughout the tropical and temperate seas of the world. Dr. Jordan assures us that a smaller species, the *Ranzania truncata* of science, has been captured in various parts of the Atlantic and Pacific, but never nearer to our coasts than the Bermudas. It is distinguished by possessing a much more elongated form. The Bermudan specimen measured only eight inches in length, and was taken as long ago as 1878 When in a sportive mood, old Sunfishes have the habit of leaping

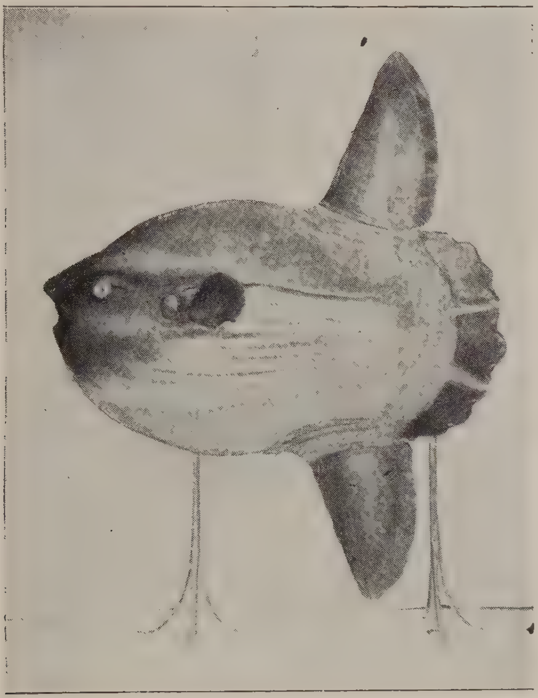

FIG. 122. LEFT LATERAL VIEW OF A MOUNTED SPECIMEN OF A SUNFISH READY FOR MUSEUM EXHIBITION.

Prepared and photographed by Mr. H. H. ter Meer, Jr., of the Leyden Museum.

out of the water something after the manner of a porpoise. This has been noticed off the coast of California, where perhaps this, one of the most grotesque of all fishes, is as abundant as it is in any other part of the world.

In the mounting of mammals the same general principles are employed. This is well-shown in the group of Jackals *(Canis aureus)*, mounted at the Leyden Museum, it being composed of the adult pair, five young ones, and a fowl which has been killed by the robber male and brought to the pups at the entrance of the den. Both the hen and the young Jackals were mounted by Mr. ter Meer's father, and are fine pieces of work in each instance, as may be seen in the accompanying reproduction of the protograph of this group sent me by the artists. We have in the accessories an excellent representation of a North African scene on the border of the desert where the sandstone soil barely supports a meager and widely scattered growth of cactus and agave. The rock masses in the scene are modeled upon cardboard by the use of Mr. ter Meer's own composition; while the forms of these bowlders were obtained from photographs of similar scenes in North Africa, kindly loaned for the purpose by Mr. Krause, conservator to the Geological Museum of Leyden; and from the same source was likewise obtained a sufficient quantity of the sand of the desert from such a place as to insure the selection of the

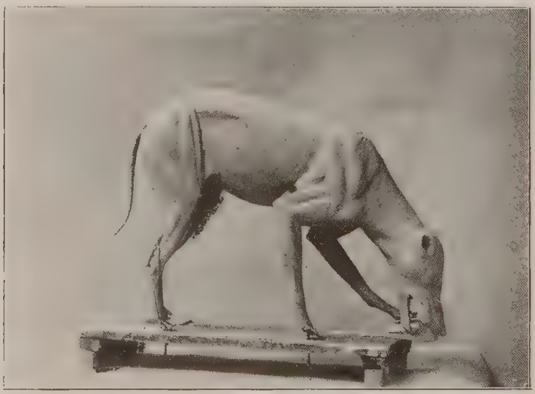

FIG. 124. MODEL OF JACKAL.

♂, showing superficial muscles: ready to receive the skin. Prepared by H. H. ter Meer, Jr.

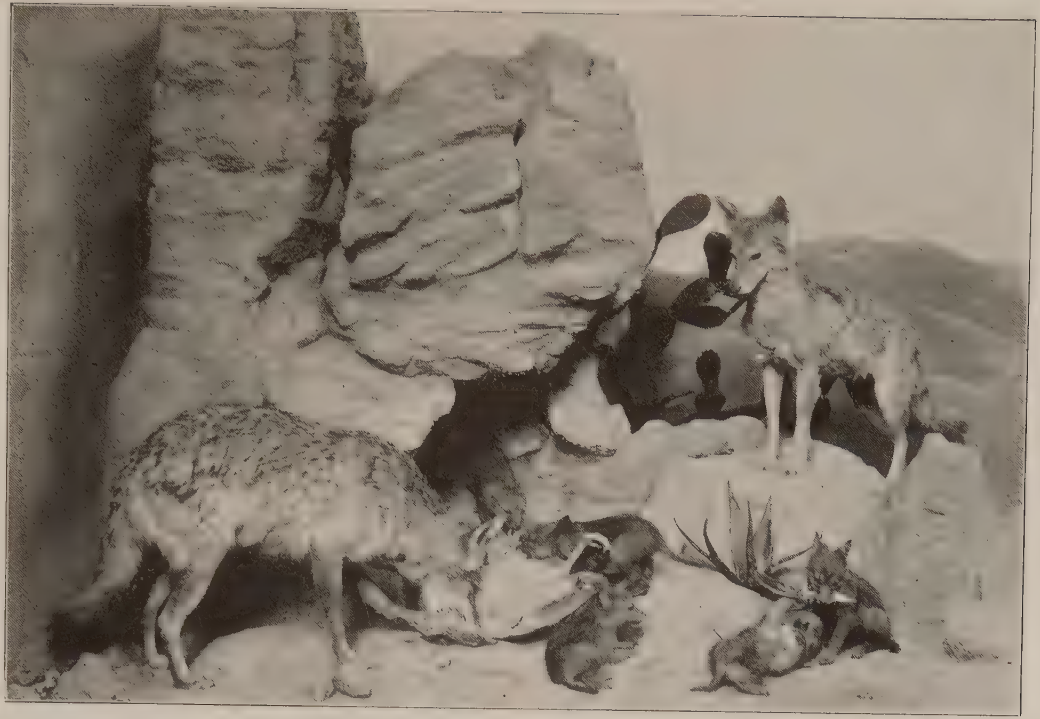

FIG. 123. GROUP OF JACKALS IN THE LEYDEN MUSEUM.

Mounted by the Messrs. ter Meer (pere et fils).

proper color to paint the rock masses after their modeling had been completed.

The female in this group of Jackals has been placed in a very natural attitude, it being one of attention, complacently regarding as she is her frolicsome progeny, two or three of which are engaged in assisting in the despoliation of the victimized fowl. The male Jackal is equally good, if not better, than the mate, for the pose is more difficult to reproduce, yet it has been admirably accomplished.

In making the model over which the skin is subsequently fixed, the same principle and the same material is followed and used as was described in the case of the Sunfish. But in the mammal, a much higher degree of skill is demanded, inasmuch as the superficial muscles require very accurate knowledge and treatment. Now in both these old Jackals all the chief muscles of the external layer were reproduced in the models, as will be seen in Figs. 124 and 125. These muscles I have carefully examined in the photographs, and find that they have been reproduced with marked fidelity to nature; they are excellent.

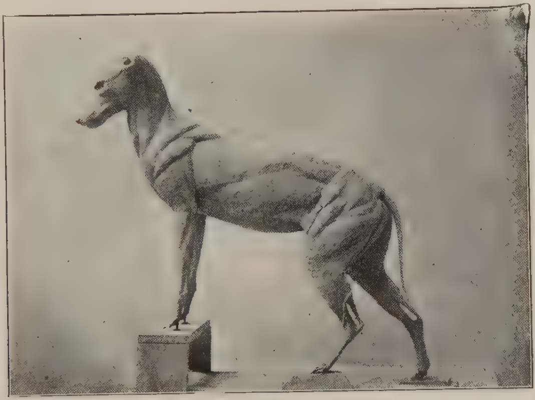

Fig. 125. Model of Jackal, ♀ (*Canis aureus*).

Companion to Fig. 124, by Mr. ter Meer, Jr.

This is the only way that perfection can be attained: We must obtain the best possible photographs of the living animal in as many attitudes as desired; we must take all necessary measurements before the skin is removed; we must take afterward casts of the carcass and make other photographs, and take plenty more measurements; we must make accurate records of the coloration of all skin and other parts as they appeared in life; and finally, in every step of the mounting we must keep nature in our eye, so that the hands faithfully reproduce all that the mind sees and our knowledge appreciates. Faultlessly reproduce nature, and in a manner that the methods employed result in rendering the work practically permanent, unchangeable, and indestructible by the ordinary action of time, pests, and climatic influences. When you can do this, fame soon follows.

Another good piece is the Fox shown in Fig. 126. It is a very neat and natural piece of work, and does the artist credit.

How often it is that some sportsman loses a favorite dog, and would love to have him prepared by the hands of the taxidermist in some natural, restful, and yet characteristic attitude, so that some nook in the gun room might harbor the hero of other days, and recall hours spent together afield in seasons long gone by. What are the results and the outcome of such a wish in the vast majority of instances? Terrible. Stiff, awkward, and scarcely recognizable. "Poor old fellow!" you say, as it is brought home, and the first desire that siezes upon you is that the hideous phantom of your old favorite be hastily and forever now removed from sight. You cannot bear to look upon those senseless eyes and that distorted form. Yet did you but possess a good photograph of the animal, and the dead companion were prepared after the methods employed at the Leyden Museum, how different the result would be; you would know your friend whenever your eye

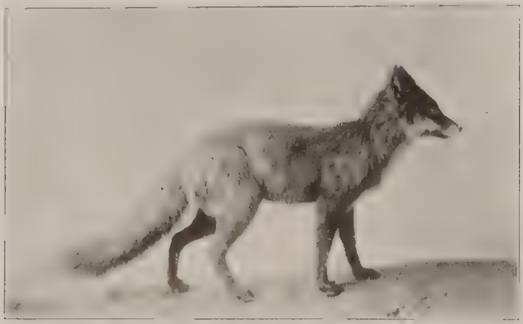

FIG. 126. MOUNTED SPECIMEN OF FOX (*Canis vulpes*).

By H. H. ter Meer, Jr., in the Leyden Museum of Holland.

fell upon it, and instead of continually wishing it out of your sight, you would, ever and anon, just for old times' sake, feel like patting it on the head, with the wish that you had the power to restore it to life.

A Jackal has always reminded me of our well-known Coyote *(Canis latrans)*, with a strong dash of the fox and dog in it; indeed, not a few of our naturalist friends in Europe are of the opinion that several of the partly domesticated breeds of dogs in northern Africa and in Asia are derived from the common Jackal *(Canis aureus)*. Canine in anatomical structure, it is also largely canine in external appearance; and in the region they inhabit there are several well-marked varieties of them. According to a good authority at hand, the Jackal resembles any of the foxy types of dogs "in dentition, in the roundness of its eye pupils, in its period of gestation, and to a large extent also in its habits, while, like the dog, it is subject to hydrophobia. It grows to a height of 15 inches at the shoulders, and to a length of about two feet, exclusive of its bushy, fox-like tail. Its fur is of a grayish yellow color, darker on the back and lighter colored beneath. An excresence consisting of a horny cone, half an inch in length, and concealed by a tuft of hair, is, according to Emerson Tennant, sometimes found on the head of the Jackal. The Singhalese aver that it is only found on the leader of the pack, and they esteem it as an invaluable talisman."

Gregarious by nature, rapacious, cunning, and thieving, these animals are a perfect pest to man throughout the country where they occur. Poultry suffer especially, though the pack will not hesitate to attack the larger quadrupeds or make prey of the smaller varieties. They hunt chiefly at night, hiding in the jungle during the daytime. A pack may consist of as many as 250 individuals; so when a raid is instituted upon the farmyard by such a canine battalion, flock and fowl usually suffer pretty severely. In the absence of fresh food a Jackal will eat carrion, and so they score at least one point in their favor by becoming at times useful scavengers. When carrion and live stock are both absent, these fellows quickly take to grapes and other small fruits, and so the vineyards and orchards suffer instead of the farmyards and sheep pens. A hyæna-like cry, peculiar and piercing, is possessed by this animal, and when a whole pack opens in chorus at night the effect is more or less blood-curdling and alarming. Captain Beechey notices it as having something rather appalling when heard for the first time at night, and he remarks that as they usually come in packs, the first shriek which is uttered is always the signal for a general chorus. "We hardly know," continued the captain, "a sound which partakes less of harmony than that which is at present in question; and, indeed, the sudden burst of the answering, long-protracted scream, succeeding immediately to the opening note, is scarcely less impressive than the roll of the thunder clap immediately after a flash of lightning. The effect of this music is very much increased when the first note is heard in the distance—a circumstance which often occurs—and the answering yell bursts out from several points at once, within a few yards or feet of the place where the auditors are sleeping."

People residing in India often find pretty good sport in hunting jackals with foxhounds and greyhounds; and, as the animal is endowed with no mean amount of cunning, he is not far behind the average fox in the chase. It is said that their bite is more than severe, and that if run down they will feign death in order to escape being taken. When domesticated, in habits and much else they remind one of certain breeds of dogs, wagging their tails when called, or crouching upon the ground when rebuked.

Like foxes, the jackals have a peculiar, not to say offensive, odor about them, due to the secretion of a gland at the base of the tail. In domesticated individuals this feature is not nearly so apparent as in the wild animals.

Jackals have been charged with the crime of grave-robbing, and especially the shallow graves of soldiers on the field after battle, but how much truth there may be in this accusation the present writer is unable to say. In the case of the coyote of the west, however, I know it to be true, for years ago, when stationed as post surgeon at a far western post, there were hung one evening near the fort two notorious "road-agents" (stage-robbers), and they were awarded shallow graves under the cottonwood-tree where they met their fate. A few days after I was collecting birds in the neighborhood, and stepping over to this place of burial, I observed a spacious burrow leading down to either body. Three or four coyotes stood off at no great distance watching my movements, and there can hardly be any doubt but that they were the authors of the desecration.

Recently I have read a senseless discussion in reference to Samson, who, it is claimed in ancient literature, placed firebrands between the tails of three hundred foxes, in order that the animals thus dealt with might set fire to the grain-fields of the Philistines. It was not the absolute impossibility of such an occurrence ever having taken place, but the narrator desired to have his readers inform him whether it was the more likely that the animals referred to in the account were Jackals *(Canis aureus)* or the common foxes of that region *(Canis vulpes)*. He is careful to point out, is this disputant, that near Joppa, about Gaza, and in Galilee, that the Jackals are far more abundant than the foxes. Speaking of foxes, there are quite a number of them in our United States fauna. For example there is the common Red Fox *(Vulpes f. fulvus)*, a larger and a handsomer animal than the common fox of Europe, shown in Figure 126 of the present chapter, and with somewhat different habits.

We also have in Arctic America and northern United States the Silver or Black Fox *(V. f. argentatus)*, and the Cross Fox *(V. f. decussatus)*, while confined in the Arctic regions we have the Arctic Fox *(V. lagopus)*. In suitable localities in the west one meets with the Kit or Swift Fox *(V. velox)*, and the Prairie Fox *(V. macrurus)*, while on the Californian coast occurs the Coast Gray Fox, belonging to a different genus *(Urocyon v. littoralis)*. This genus also contains another species of general distribution in this country southward as far as Costa Rica; I refer to the Gray Fox *(U. virginianus)*. Doubtless there are other varieties that have been found, or are yet to reward the researches of the explorer. Coyotes are more closely related to the wolves *(Canis latrans)*, as the common gray wolf of North America *(C. lupus griseo-albus)*. What has been written about foxes would certainly fill many goodly volumes, and these cunning animals surely deserve to have their exploits thus preserved. There are about thirty or thirty-five species of *Vulpes* known, and by no means a few good subspecies.

All of these animals of which I have been writing about here belong to the very interesting group of dog-like forms, constituting the family *Canidæ*. As a whole this group or section has been termed by naturalists the *Cynoidea*, it being one of the divisions of the true order of the carnivora. To it belong all the breeds of the common domestic dogs, the origin of which is still a matter of doubt in the minds of mammalogists. Then it includes the fine series of wolves and foxes of various parts of the world as well as certain types of small and elegant fox-like animals of

Africa, that develop enormous ears, and are endowed with extraordinary powers of hearing. The Fennec and the Otocyon are good examples of these last-named genera. We have much to learn about them yet. The Dingo of Australia, a fox-like dog, occurs both wild and in a semi-domesticated state as a companion of the aboriginal people of that land.

Many naturalists and anatomists have devoted themselves to the history of this group, and the researches of the palæontologists in various parts of the world have been rewarded by finding the fossil remains of different species of the *Canidæ*, and not a few of their extinct allies.

Among unskilled and thoughtless taxidermists the opinion is more or less prevalent that in the case of mounting any large mammal endowed with a heavy coat of hair—a long and thick pelage in other words—it becomes unnecessary in manufacturing the model to take any pains in reproducing the superficial muscles as they occur in life. This is undoubtedly a great mistake, and is doubtless best exhibited in such a group of animals as we see in the bears. If a taxidermist, in making his model for a bear, makes the body and limbs round and smooth, and utterly ignores the sulci and elevations created thereon by the various groups of muscles of the external muscular layer, he deceives himself; and when the animal's skin is placed over such a model and adjusted with the view of having the specimen appear life-like, it will be found to be quite impossible and the result far from a natural appearance, and consequently to that degree unsatisfactory. In Fig. 127 is shown a reproduction of the photograph of the model that was made for a Polar bear and used in its mounting. It will be seen that considerable pains were taken in carving out the superficial muscles as they are developed in life, and the great advantage gained thereby is at once apparent in the finished specimen here shown in Fig. 128.

The large tendon in each hinder limb, the muscles of the thighs, of the shoulders, and the fore part of the neck, as sculpt in the model, have all had their influence in giving character to the finished piece, and the general result and effect are most admirable.

As I have remarked, the Polar bear shown in Fig. 128 is but a young animal, and the subadult specimens of this species are larger than the adults of some other kinds; indeed, a full grown Polar bear is said to exceed in size the largest Grizzly. Records are not hard to find of their having attained a length of 9 feet and a weight of 1,600 pounds. It is claimed by some that in the case of this species the female alone hibernates, and that the male may be seen abroad at all seasons. Owing to the fact that this bear is an arctic variety, the sportsmen of the country but rarely have the opportunity of hunting it; and consequently we must turn to the accounts left us by the famous explorers of those frigid regions in order to gain any knowledge of the habits of this species. Sabine, Cartwright, Lyon, Sir John Ross, Sir Edward Perry, Franklin, Richardson, Dr. Kane, and a host of more recent explorers have made the habits and geographical range of *Thalassarctos* well known to us; and these narratives are of a nature sufficiently exciting to arouse the enthusiasm of one who perhaps has become more or less satiated by the untold numbers of black bears and grizzlies he has slain.

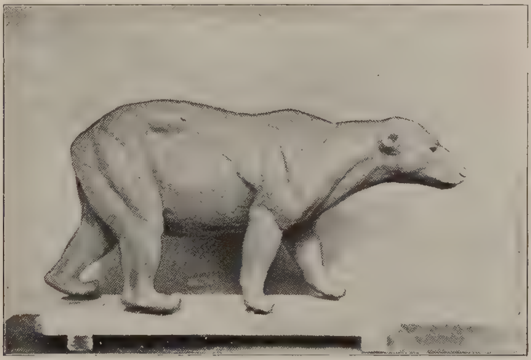

FIG. 127. FINISHED MODEL FOR YOUNG POLAR BEAR (*Thalassarctos maritimus*).

A peculiar character seen in the Polar bear is that this species has a good growth of fine hair upon the soles of its feet. It is a remarkable nice provision, for it not only keeps the animal's pedal extremities warm while tramping over the ice, but it also renders the slipping about upon the same footing far less likely. There are some splendid bear pits here in the National Zoölogical Gardens of Washington, D. C., and among the various species of bears confined therein we also find two or three fine examples of the Polar. Their habits in confinement are very interesting and well deserving of close study, and this study has been bestowed upon them in many of the zoölogical gardens of the world.

Speaking of zoölogical gardens and Polar bears reminds me of an instance that fell within my own experience a good many years ago. Dr. W. A. Conklin was, at the time referred to, the superintendent of the gardens of Central Park in New York City, and he was doing the writer the honor of showing him the animals under his charge, as well as the general arrangement of his then much cramped institution. We were standing in front of the bars that confined the Polar bears to their pit; an old male of the species within his prison stood close to us, and he was yawning most heavily. A young city Arab about fifteen years old, lustily smoking a cigarette, had strolled up and stood next to me in front of the bars. As the bear gave his perhaps final deep yawn it appeared to be too much for this depraved son of the streets, who, with a precision equaled only by the brutality of the act, tossed the lighted end of his finished cigarette down the gaping throat of the ursine representative of the boreal regions of the earth. The animal, smarting under the sudden and intense pain, first snapped his powerful jaws together, the peculiar noise created thereby attracting not only the attention of Dr. Conklin, but also that of all the spectators standing nearby. But this was not all, for the now infuriated bear rose to his full height upon his hind legs and gave vent to a roar that seems to me ought to have been distinctly heard by another entirely different kind of bear, or bears, down in their Wall street dens. Dr. Conklin quickly turned to me, to ascertain if I knew what in the world could be the matter with the fellow, when, with equal promptitude, the nature of the case was pointed out to him. Without a word of warning he pounced upon the culprit, and begging me to accompany him, he was, with many a hearty shake and admonition, ushered into the presence of the park police court, where a stiff fine was very soon imposed upon the fiendish perpetrator of the deed. As we passed away from the pit I turned back, and noticed the outlandish capers of the poor bear as he smarted under the sudden pain to which he had been inflicted.

With respect to the small carnivora, we find a well-mounted piece of the Pine Marten (*Mustela martes.* Linn.) that I am permitted to present in Fig. 126, it being the reproduction of a photograph of a specimen of that animal mounted by Mr. ter Meer, Jr.

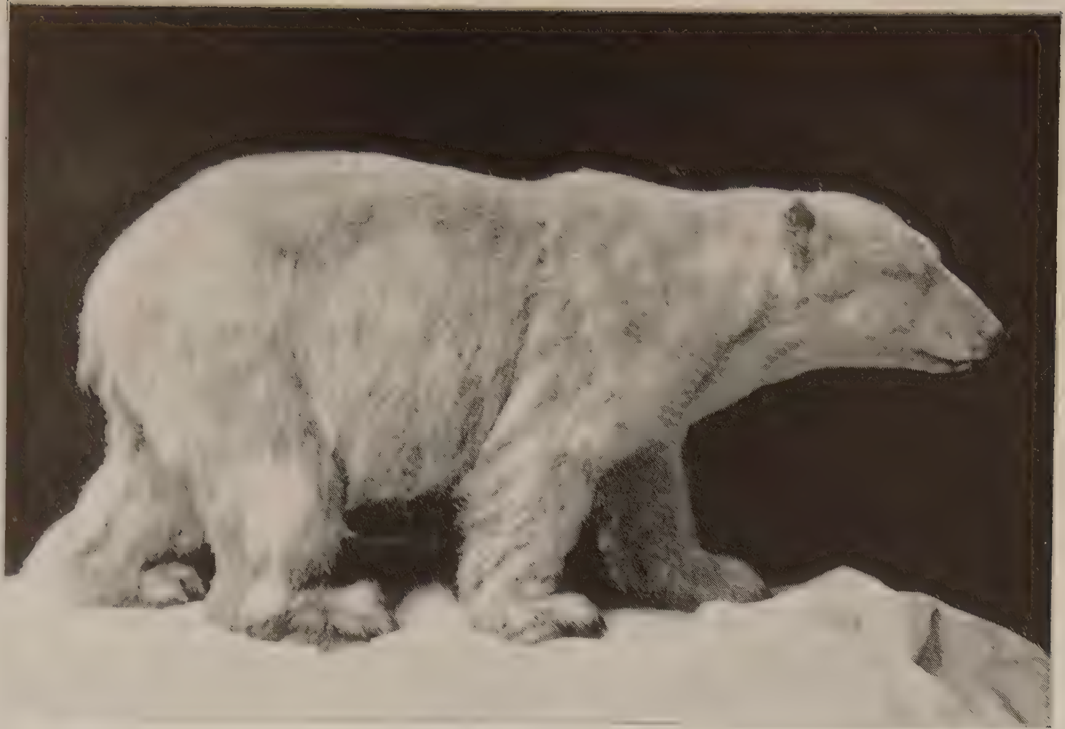

FIG. 128. MOUNTED SPECIMEN OF YOUNG POLAR BEAR (*Thalassarctos maritimus*).

Prepared by Mr. ter Meer, Jr., and now in the Leyden Museum.

This appears to be a very accurate piece of work, and if one will compare it with the figure of this species that illustrates the article Marten in the ninth edition of the Encyclopædia Britannica (Vol. XV., p. 577), it will at once be appreciated that there are some striking points of difference. These differences refer especially to the snout and the tail; the former being too acute in the aforesaid drawing, and the latter not near full and bushy enough. I find this to be the case with respect to other well-known figures as compared with the Leyden Museum specimen. Here is an instance, then, wherein the camera triumphs over the unaided eye of the artist in portraying objects of this kind. And the more this instrument is scientifically used in this direction, so much the better will it be for the interests of pictorial zoölogy.

According to Sir William H. Flower, the Martens constitute a small but well-defined section of the family *Mustelidæ*, belonging to theArctoid or Bear-like division of the order *Carnivora*. The Pine Marten is one of the best known species of this group, and is found in various localities throughout northern Europe and Asia. It is hardly to be distinguished from the North American Sable, or Marten *(M. americana)*, of the fur countries of this continent. A closely related form, both in structure and habits, is the Beech Marten *(M. foina)* of the more boreal districts of the Old World, Sweden and Norway excepted. In eastern Siberia the true Sable exists *(M. zibellina)*; while in Japan we have still another species, the *M. melampus* of science. *M. flavigula* occurs in some parts of the Himalayas, Ceylon, Java, and the Malay Peninsula. Lastly, in the more northern parts of the United States and British America, we meet with the famous Pekan, or Fisher, sometimes called Pennant's Marten; quite a remarkable animal.

Be it remembered, then, that out of the genus *Mustela* we have at least two well-recognized species of Martens in the United States, viz., the American Sable *(M. americana)*, and the Pekan *(M. pennanti)*. With us the family *Mustelidæ* also contains the otters, the skunks, the badgers, the wolverine, the mink, the ferrets, the ermine, or stoat *(Putorius erminea)*, and the weasels. A quite extensive literature has been devoted to the *Mustelidæ*, that is full of interest even for the general reader, but my space limits will not admit of my touching upon the natural history and geographical distribution of these animals in the present connection. In passing I am compelled to remark, however, that I have been greatly surprised at the inaccuracy of many of the figures of the representatives of this group throughout the works devoted to their biology, and that zoölogical photographer who gives his attention to making serviceable photographic illustrations, from life, of any of these animals, will indeed not have squandered his time, nor misplaced his labor, for biological science will have been distinctly benefited thereby.

In mounting a specimen like the South American Ostrich, better known as the Rhea *(Rhea americana)*, the same plan is followed, and requires no detailed description here after what has already been set forth above.

Existing Ostrich-birds form a distinct division of the Class *Aves*, and include such forms as the true ostriches of Africa; the cassowaries, emeu, and the rheas; while the extinct types known to us are the moas and the roc. Some authors include the kiwis and tinamous in this group, but from such a view the present writer departs. Of the genus *Rhea* we have three species in South America, inhabiting different regions, the precise limits of which have not as yet been distinctly defined. There are the Nandu *(R. americana)* (Fig. 130); the Patagonian rhea, or Petise *(R. darwini)*; and the Long-billed rhea *(R. macrorhyncha)*. Newton in the *Dictionary of Birds* remarks: "On the 'pampas' *R. americana* is said to associate with herds of deer *(Cariacus campestris)*, and *R. darwini* to be the constant companion of guanacos *(Lama huanacus)*; just as in Africa the ostrich seeks the so-

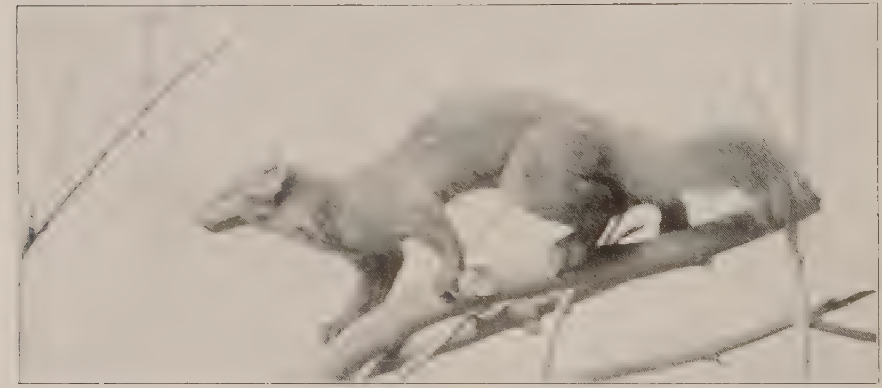

FIG. 129. MOUNTED SPECIMEN OF THE EUROPEAN PINE MARTEN (*M. martes*).

Property of the Leyden Museum, and prepared by H. H. ter Meer, Jr.

ciety of zebras and antelopes. As for *R. macrorhyncha*, it was found by Forbes *(Ibis*, 1881, pp. 360, 361) to inhabit the dry and open ‘sertoes’ of northeastern Brazil, a discovery the more interesting since it was in that part of the country that Marcgrave and Piso became acquainted with a bird of this kind, though the existence of any species of Rhea in the district had been long overlooked by or unknown to succeeding travelers.” (Part III., p. 788.)

The Nandu is not nearly so big as an African ostrich, and it, among numerous other characters, is further distinguished from it by the structure of its plumage, the fact that it has three toes upon each foot instead of only two, and by the head being nearly completely feathered. Its plumes have none of the beauty of those of the true ostrich, which is doubtless a very fortunate circumstance for the bird, as man can only find use for them in the manufacture of light dusting-brooms. Although not of recent date, some of the best natural history accounts of the Nandu are to be found in Mr. Darwin’s famous work, *The Voyage of the Beagle*, while not a few other authors have given descriptions of

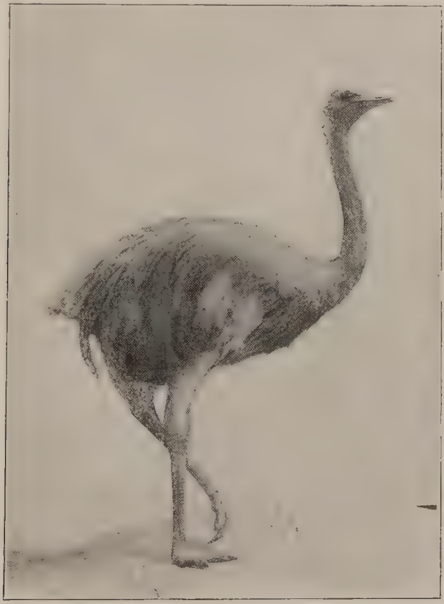

FIG. 130. RHEA AMERICANA.
Collection of the Leyden Museum in Holland. Mounted by H. H. ter Meer, Sr.

the exciting hunts for these great birds of the plains, and how the lasso and bolas are used in their capture by the horsemen pursuing them. With the wind in their favor, however, and setting their wings as sails, the Nandu in the race soon leaves a horseman astern. Consequently the huntsmen are obliged to partially surround them, several riders usually forming the hunting party. These birds, although slow, are by no means bad swimmers, and take to the water most readily. Frequently, too, they will feed upon small fish, though roots and grass compose their ordinary diet. Darwin noticed that they would squat down and conceal themselves in the tall rushes of the river-banks and remain in such a situation until closely approached by the one who observed them; and this eminent writer says the "inhabitants of the country readily distinguish, even at a distance, the cock bird from the hen. The former is larger and darker colored, and has a bigger head. The ostrich, I believe the cock, emits a singular, deep-toned, hissing note. When first I heard it, standing in the midst of some sand-hillocks, I thought it was made by some wild beast, for it is a sound that one cannot tell whence it comes, or from how far distant."

In a foot note to these remarks he adds, "A Gaucho assured me that he had once seen a snow-white or albino variety, and that it was a most beautiful bird." A nest of this species is a mere shallow excavation, containing on the average from twenty to thirty eggs; the male alone incubates and cares for the brood. Many additional eggs are dropped by the hen over the pampas that are never hatched. The cock is a close sitter, allowing himself almost to be ridden over before taking himself off; several hens are said to lay in the same nest, and as many as fifty eggs have been found in one. Azara says eighty. Cock birds are dangerous when in charge of the brood, and will even attempt to kick a man off a horse.

Among British ornithologists the best published accounts of the three species of Rhea are given by Darwin, Sclater, Newton, Harting, Forbes, and Cunningham. Sir Richard Owen, Prof. Huxley, and Dr. Gadow have written much upon their anatomy; while travelers of other nationalities, as Azara, Prince Max of Weid, and Prof. Burmeister, have left us many interesting descriptions of their habits and general natural history.

THE END.

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